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SPANISH EXPERIMENTS IN COINAGE.

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MUCH instructive research has of late years been devoted to the history and inevitable results of paper inflation. The French assignats, our own continental money, colonial overissues, and the practically irredeemable currency of the banks of some of the States prior to the civil war have furnished subjects for elaborate discussion and have yielded their appropriate warnings; but I am not aware that the most remarkable and significant of all attempts to create and sustain fiat money has ever received the attention which is its due. I term it the most remarkable because it was made with coin and not with paper, and the vitiated currency was comparatively small in amount, because it was carried on for more than two centuries with true Spanish persistency, and because it permanently and disastrously affected the destinies of a great nation. Many causes contributed to the decadence of Spain, but, after the expulsion of the Jews and Moors, none perhaps did more to destroy its industry and commerce than its vicious currency legislation. The story is a long one, and I can here touch only on its more salient points. If some of the measures adopted should seem incredibly violent, it must be borne in mind that they were the devices, not of rude and unlettered savages, but of the best trained and most experienced statesmen of the land vainly seeking to escape the consequences of the first fatal step in the wrong direction. The lesson taught is the more impressive from the fact that, in the sixteenth century, Spain was by far the richest and most powerful state in Europe, practically owning Italy through her hold on Naples, Milan, Sicily, Sardinia, and Corsica, and mistress of the wealthy provinces of the Nether-

lands. She, moreover, enjoyed the monopoly of commerce with the New World and its stores of precious metals; and this enormous power, military and financial, was wielded by an absolute monarch who combined the legislative and executive functions unhampered and unrestrained. If ever a successful attempt could be made to overcome the self-acting laws which govern trade it could be made by Philip II and his successors.

Like all other mediæval kingdoms, Castile had had ample experience of the evils of an uncertain standard of value. In the latter half of the fifteenth century the feeble Henry IV, among other devices to secure the allegiance of faithless magnates, parted freely with the right to coin money, until there were about a hundred and fifty private mints scattering their issues throughout the land. The crown itself reduced the standard of gold coin to 7 carats, while the irresponsible private coiners debased it to whatever their cupidity dictated. When Ferdinand and Isabella came to the throne their resolute sagacity speedily put an end to this deplorable condition. In their final legislation the gold standard was fixed at 23¾ carats; that of silver at the one traditional in Spain known as 11 *dineros* and 4 grains, equivalent to 0·925 fine. The marc, or half pound, of gold, containing 4,608 grains, was worked into 65½ *excelentes* or ducats, also known as *escudos* or crowns. The marc of silver was worked into 67 *reales* or ryals. The monetary unit was the *maravedi*, of which there were 34 to the ryal and 374 to the crown, there being thus 11 ryals to the crown. For convenience in small transactions there was an alloy known as *vellón*, consisting of 7 grains of silver to the marc of copper, the marc being worked into 192 *blancas*, the blanca being half a maravedi, and the value of the marc of alloy and the cost of coinage being reckoned at 96 maravedis.*

In 1537 Charles V reduced the standard of the gold crown to 22 carats and its weight to 68 to the marc, diminishing its value to 330 maravedis, which he says brought it to an equality with the best coinage of France and Italy. In 1552, moreover, he reduced the silver alloy in the marc of vellón from 7 to 5½ grains, giving as a reason that there had been a profit in the exportation of the

* It will perhaps facilitate the comprehension of the Spanish coinage to remind the reader that the *peso* or *real de á ocho*, the "piece of eight," containing 8 ryals, is the Spanish dollar, adopted as our monetary unit by act of Congress in 1786. The ryal is thus one eighth of a dollar, or 12½ cents, well known to the older generation, when our silver currency was almost exclusively Spanish or Mexican, as the "ninepence" of New England and Virginia, the "shilling" of New York, and the "elevenpenny bit" shortened to "levy" in Pennsylvania, or to "bit" in the West and Southwest. Our "quarter" was the two-ryal piece or *peseta*, and the "pistareen," which rated at 20 cents, was the similar coin of an inferior currency, which, as we shall see hereafter, was known as "provincial."

The maravedi, as the thirty-fourth part of the silver ryal, was equivalent to nearly three eighths of a cent.

blancas, rendering them scarce at home. Thus far there had been no serious tampering with the currency, but not long after this, in 1566, the necessities of Philip II led him to seek relief in debasing the minor coinage. It is true that he was the richest monarch in the civilized world; that, besides his revenues from his European dominions, the crown claimed twenty per cent of all the precious metals mined in the Indies and ten per cent seigniorage for minting the rest; but the Venetian envoy Paolo Tiepolo tells us in 1565 that his expenditure for interest alone was 5,050,000 ducats per annum, which, when capitalized at eight per cent, amounted to 63,000,000 ducats of indebtedness—a sum incredible even to the Italian financiers of the period. He had little scruple as to the means of alleviating the burden. In 1559 he had experimented with methods suggested to him of issuing money falsified with a certain powder combined with quicksilver, which when rubbed over copper gave it the semblance of silver, and was proof, as we are told, against the touchstone and the hammer, but not against fire. One inventor of this promising scheme, named Tiberio della Rocca, lost Philip's favor through a quarrel with the royal confessor; another one, a German named Peter Sternberg, was more fortunate, and secured payments amounting to 2,000 ducats for his discovery; but, although every effort was made to keep the matter secret, the Córtes got wind of it, and their remonstrances forced the abandonment of the scheme.

Compared with this wholesale fraud, an enlargement of the token coinage of base metal might well seem harmless, and it is a striking proof of the dangers attendant on any vitiation of the currency that consequences so deplorable and so lasting should have sprung from a source apparently so trivial. In 1566 Philip ordered the coinage of a new alloy, to be known as *moneda de vellón rica*, with a larger proportion of silver—98 grains to the marc of copper, or about $\frac{1}{17}$. The coins were all small: *quartillos*, 80 to the marc, to be current for a quarter of a ryal (about three cents); *quartos*, 170 to the marc, worth four maravedis (about a cent and a half); and *medios quartos*, 340 to the marc, worth two maravedis. At the same time the old blancas, two to the maravedi, were retained, but the silver alloy was reduced to four grains in the marc; and the number to be worked from the marc was increased to 240, augmenting the profit on every marc by a ryal and a quarter. What amount of this new vellón coinage was poured forth from the mint we have no means of ascertaining, but there can be little doubt that it was as great as the rude mechanical facilities of the age were capable of producing, for Philip's necessities were ever growing, what with the construction of the Escurial, the perpetual drain of the Flemish revolt,

the maintenance of the religious wars in France, the conquest of Portugal, the crusade which brought the triumph of Lepanto, the collapse of the Armada, and other ceaseless efforts, prompted by zeal for the faith and thirst of aggrandizement. Yet the infiltration of the currency with these little debased coins was a slow process, and its effects were correspondingly deferred, but they manifested themselves at last, and the *calderilla*—as this coinage came to be popularly designated—grew to be a load which the ablest statesmen of Spain for a century vainly endeavored to shake off. Apparently the process of manufacture became too slow to supply the increasing wants of the treasury, for we hear in 1602 of a restamping of the vellón coinage, doubtless to give it an increased fictitious value. At the same time Philip III made a new issue of pure copper, to the amount of 2,448,000 ducats, working 280 maravedis to the marc, the cost of metal and coinage being only 80 maravedis. Prices rose, and there was general discontent, voiced by the learned historian Mariana in a tract on the coinage written with so much vigor that it cost him an imprisonment by the Inquisition. Thus the reservoir became filled to overflowing, and the inevitable depreciation commenced. To arrest it Philip III, in 1619, solemnly decreed that there should be no more vellón money coined for twenty years; but financial promises of this nature are made to be broken, as is witnessed by Philip IV, in 1632, renewing the pledge conditionally for another twenty years. In spite of these promises, the vellón fell to a discount. There was no formal suspension of gold and silver payments; the silver fleet from Mexico and the galleons from Tierra Firma yearly poured into Spain the treasure won from the mines of the New World; but all the power of an autocratic sovereign could not maintain the parity of the currency. The inequality became so firmly established that it had to be recognized, and Philip IV, in 1625, endeavored to regulate it by a decree permitting a difference of ten per cent. Beyond this any transaction entailed on the receiver, for a first offense, the forfeiture of the principal with a fourfold fine, applicable in thirds to the informer, the judge, and the fisc; for a second offense, the same, with the addition of six years' exile. At the same time it was enacted that no one could demand gold or silver who had not given them, and no obligation to pay in gold or silver was lawful unless gold or silver was lent. These provisions show that already the vellón coinage had risen from its function as a token currency in petty dealings, and was rapidly becoming the standard medium of exchange in all commercial transactions. It is as such that we shall have henceforth to consider it, and it is to this that it owes its importance.

The situation was growing insupportable. Commerce and industry were equally stagnant. No land in Europe had greater resources than Spain in the fine wools of Castile, Aragon, and La Mancha; the flax and hemp of Asturias, Catalonia, Galicia, and Leon; the excellent silk of Murcia and Valencia; the iron, steel, and timber of Navarre, Guipuscoa and Biscay; the wines and fruits of Andalusia; but these were all exported as raw materials, and though the trade of the Indies was a jealous monopoly, half the goods sent thither in the fleets were the property of Hollanders, under the names of Spaniards, although Spain was at war with Holland. Partly this was attributable to the disordered currency, and the communities throughout the Peninsula supplicated the crown for relief. There was but one way to obtain this—by retracing the vicious course of the last half century, and the attempt was heroically made. By a *pragmatica* of August 7, 1628, it was decreed that after the day of publication all the vellón money should be reduced one half in value. To diminish the loss to the holders a complicated arrangement was ordered, by which one half of the depreciation should be made good to them by their towns and villages, and in view of the sacrifice thus imposed on the nation the royal faith was solemnly pledged by Philip IV, for himself and his successors, with all the force of a compact between the crown and the people, that the value of the vellón coinage should never again be tampered with, either to raise or to depress it. After this, any transaction disturbing the parity of the various coinages was declared an offense subject to the severest punishment and to render the measure effective the sternest penalties were directed against the introduction into the kingdom of foreign vellón money. The profits on this had already called forth the most vigorous efforts of repression, and these were now sharpened by declaring it to be a matter of *lèse majesté*, and subjecting it to the pains of heresy—death by fire, confiscation of all property, and disabilities inflicted on descendants to the second generation. Any vessel bringing it, even without the knowledge of the master, was forfeited; an unsuccessful attempt to import it was punished with death, and knowledge of such attempt without denouncing it incurred the galleys and confiscation. For a while, in fact, the crime was made justiciable by the Inquisition, which was a tribunal inspiring far greater popular dread than the ordinary courts. Evidently the law-making power in Spain had few scruples, and no constitutional limitations in its control over the currency.

Yet with all its power it might as well have attempted to control the tides or the winds, and the solemn pledges of the throne were not worth the paper on which they were printed. Richelieu was pressing Spain hard, and the condition of Spanish finance

was becoming more and more desperate. Recourse was again had to a forced loan under the device of another inflation of the currency. A royal *cédula* of March 12, 1636, called in all the restamped vellón; from the day of publication of the edict no one was to pass it, or spend it, or pay it out, but was to convey it to the nearest mint, where he would receive its current value; and whoever, after eighty days, was found in possession of any of it incurred the severe penalties decreed against the holders of unlawful money. Having thus provided for obtaining possession of all the coinage, the mints were set to work restamping it with a valuation threefold that which it had borne: the *quarto*, thus far current for four maravedis, was raised to twelve, and the other coins in proportion, while death and confiscation were threatened for any violation of the coinage laws. The result of this arbitrary creation of value is seen in the edict of April 30th of the same year, permitting a premium on gold and silver of twenty-five per cent until the arrival of the galleons, after which it was to be reduced to twenty; and that this was below the ruling market rate is assumable from a sharpening of the penalties provided for those who should demand or accept a higher premium. Six months later an effort was made to bring the precious metals to par by suspending the permission to exchange them at a premium, but the distress caused by this suspension was so severe that a decree of March 20, 1637, renewed the recognition of twenty-five per cent premium, and added that in the larger cities *casas de diputación*, or exchanges, could be established, where transactions could be negotiated at twenty-eight per cent, with a brokerage of one quarter or one half. The extreme importance attached to regulating the premium is visible in the punitive clauses of the edict. Any deviation from the established rate was classed with treason, irrevocably punishable with confiscation, disability for office, and personal infamy. In prosecutions all reasonable means of defense were withdrawn from the accused; the names of witnesses were kept secret, and judicial forms were not to be observed. Even ambassadorial immunity was set aside; the foreign ministers resident in Madrid were liable to accusation, when the king would determine as to their imprisonment and punishment.

This was speedily followed by a reaction. Of course, there were two parties in Spain, as elsewhere—inflationists and contractionists—and the policy of the state fluctuated as one or the other obtained preponderance with the king, or rather with his all-powerful minister, the Count-Duke Olivares. The contractionists now had control, and their views were expressed in a *pragmatica* of January 29, 1638, which lamented the misfortunes brought upon the land by the superabundance of vellón money which had

injured commerce, had raised extravagantly the prices of the necessaries of life, and had driven silver out of circulation, depriving it of its natural function as money and converting it into a commodity to be bought and sold, while the only currency was the debased coinage, fabricated for the most part by the enemies of Spain, eager to gain the enormous profits accruing from its manufacture. As this, if unchecked, may work the ruin of the kingdom, the king declares that he has had the matter repeatedly discussed by his ministers, and as the result he orders that all the unstamped vellón money shall be melted down into bullion and be sold for silver, the proceeds being used to purchase more of the precious metal. It is expected that the vacuum thus created will bring silver into circulation, and to aid in this all the bullion brought by the galleons shall be coined; moreover, the savage edict of 1628 against the introduction of vellón is repeated; even the importation of copper is prohibited, and the laws forbidding the export of the precious metals are ordered to be enforced with the utmost rigor.

Had this policy been steadily pursued, perhaps it would in time have restored health to the currency, but it was neutralized by the financial exigencies of the state, which kept the mints busy in turning out debased coinage. It was impossible under the circumstances for the contractionists to win more than a temporary ascendency, and with the progressive dilution of the currency the premium on the precious metals obstinately kept advancing, in spite of the laws which punished such traffic as a crime. A decree of January 21, 1640, declares that this has become more inexcusable in view of the large amount of silver brought by the galleons in 1639 and the activity of the mints in coining vellón. To render its chastisement more certain, the rate of twenty-eight per cent is permitted in open market, but only for four months, after which it will be lowered; special judges are provided whose sole business shall be to try infractions of this law; every case that is heard of shall be prosecuted, and negligent judges shall be severely punished. The laws forbidding the export of the precious metals shall be still more vigorously enforced, especially those which require merchants bringing foreign goods into the country to take away an equivalent amount in merchandise.

The revolt of Portugal and Catalonia brought fresh financial complications, and recourse was again had to the ruinous expedient of a further debasement of the currency. A *cédula* of February 11, 1641, orders all the four-maravedi vellón pieces to be surrendered to the mints, where they will be paid for at their current value; this is to be done within thirty days, after which they can not be paid out or otherwise used. They are then to be restamped and issued at the valuation of eight maravedis; all

other restamped vellón is to be surrendered by May 15th, after which it is to be no longer current, and disobedience of these orders is visited with death and confiscation. The natural result of this measure is seen in a decree of September 5th of the same year, limiting the premium on specie to fifty per cent until the arrival of the silver fleets. That this was below the market rate is shown in the prohibition of all indirect ways of evasion and of dealing in futures. How this condition affected all transactions, large and small, and how business was conducted under the double standard, are illustrated in some statements now before me of the expenses of the Supreme Council of the Inquisition about this time. After summing up the aggregate of the salaries and other items, in one case twenty-eight per cent and in another fifty per cent is added to show the total amount to be provided in vellón. When governmental outlays were thus increased we can not wonder at the struggle to keep down the premium on the one hand while stimulating it on the other by constant dilutions of the currency. The situation affords a singularly forcible illustration of the power possessed by an inferior money to force a superior one out of circulation. The largest of the debased coinage was only a piece of a quarter of a ryal, equivalent in our modern American system to three cents, yet it had completely demonetized silver and gold, and had become the practical standard of value. The Spanish possessions were the chief source from which the civilized world obtained its supply of the precious metals, yet Spain, in spite of the most arbitrary measures, could retain none of them within her borders. So scarce had they become that for twenty years, from 1623 to 1642, there had been repeated decrees forbidding the use of gold and silver in the arts—their melting and fashioning by artisans, even their employment for plating and gilding and in embroidery. In 1642 these laws were supplemented by others prohibiting the sale of silver plate except to be broken up for coinage, and owners were tempted to bring it to the mints with the promise of a bonus of five per cent in vellón, in addition to the coin that it would yield. At the same time the laws against exportation were rendered still more rigorous, suspending even licenses to carry silver away for the royal service in Flanders and Italy.

The contractionist policy was now granted another trial, and a comprehensive scheme was evolved to get rid of the intolerable burden and bring all the various kinds of coinage to a parity. The partial attempt of 1628 had proved a failure; but if all the base money in the land could be controlled, there was reasonable prospect that another effort might be successful. To accomplish this a *pragmatica* was signed August 31, 1642, and sent under seal to the local authorities everywhere with instructions to open it on

September 15th. At the same hour throughout Spain they were to go to the shops of all bankers, brokers, agents, traders, etc., seize whatever vellón money they should find, weigh it, register it, and convey it to a secure place, where it was to be kept under three padlocks, the keys being held by as many officials. When this was done they were to proclaim that the value of all vellón money was reduced to one sixth: the piece that had been circulating for twelve maravedis was in future to be worth but two, and so forth. All discount or premium between the metals was prohibited for the future, under the customary severe penalties, and it was hoped that the general benefit thus derived to the community at large would compensate for the losses inflicted on individuals, but to lessen these there were vague promises held out of satisfaction to be adjusted by the registry of the amount of vellón seized; and it was suggested that the king would consider any propositions made by those who should prefer honors or privileges or some other advantages in lieu of satisfaction.

Apparently it was soon found that something more was needed to bring the refractory metals closer together, and a *cédula* of December 23d endeavored to accomplish this by diluting the silver coinage. The marc of silver, in place of furnishing sixty-seven ryals, was ordered to be worked into eighty-three and one *quartillo*, thus diminishing the value of the ryal by twenty-five per cent; and in accordance with this, the existing *pesos*, or pieces of eight, were declared to be worth ten ryals, the profit on those in private hands being generously left to the holders. Gold was more simply treated by marking up the crown from 440 to 550 maravedis, and by a subsequent decree of January 12, 1643, to 612. The effect of this on the specie premium was, however, neutralized by diminishing from 98 grains to 75·3, the amount of silver to the marc of copper in the *moneda de vellón rica*, and holders of the white metal were tempted to have it thus employed by offering to coin it for them in vellón without charge of seigniorage.

Taken as a whole, these decrees formed but a halting measure of contraction; but, even as it was, it brought a strain too sudden and severe to be endured, and the effort was soon abandoned. A *pragmatica* of March 12, 1643, announced that the vellón coinage (except some recent issue by the mint of Segovia) should in future be current at a fourfold increase of value, the piece of two maravedis being raised to eight and the rest in proportion. The dilution of the silver coinage was similarly revoked, or at least suspended until the arrival of the fleet; the pieces of eight were to be current for eight ryals and no more, while the gold crown was reduced to 510 maravedis. As usual, the royal word and faith were pledged that there should be no further variation in the value of the vellón coinage, and that it should remain forever

on the basis then assigned to it. Of course, the premium on the precious metals reappeared, and efforts to repress it by law were vain. It had to be recognized, and in 1647 a decree permitted it to the extent of twenty-five per cent, with stern punishment for those who should exceed the limit.

There could be no prosperous trade subject to such fluctuations in the standard of value, and the royal revenues must have suffered accordingly, for the next change was distinctly a method of raising money. The old *calderilla* coinage of Philip II had remained thus far undisturbed, and now by a *cédula* of November 11, 1651, all the rest of the base coin was restored to the value which it had borne prior to the reduction of 1642. The profit of this increase was reserved to the crown by requiring all holders of vellón to bring it to the mints within thirty days, after which it was demonetized and could no longer be used as currency. They were to receive its present value in the restamped issue at the new rate, and any one hoarding or passing the old money after the expiration of the limit incurred death and confiscation. The premium on specie, in spite of the law of 1647, had already reached fifty per cent, and the sternest penalties were decreed to prevent its rising above that figure—for a first offense, confiscation and six years of *presidio* (service in the African forts) for nobles, confiscation and six years of galleys for plebeians; for a second offense, death without distinction of rank. If absolute power could regulate values, Spanish thoroughness would have accomplished it.

Kings may propose, but in matters like this it is the people that dispose. The natural result of this measure was to drive not only the precious metals but even the *calderilla* out of circulation. It required only six months to demonstrate the error committed, and a heroic effort to bring some sort of order into the medium of exchange was made in a *pragmatica* of June 25, 1652. Under this the old *calderilla* remained unchanged, but the *vellón grueso*, or large coinage, which had been advanced in value six months before, was reduced to one fourth, at which it was to be current until the end of the year, and on January 1, 1653, it was to be demonetized and its use prohibited under the severe penalties for passing false money. The plan of seizing it all and sequestrating it at a given hour throughout Spain was adopted, but the crown proposed to assume the loss, not only on about seven millions of the restamped coin in the treasury, but by giving to those who surrendered it assignations on the tobacco tax, bearing five per cent interest. All arrears of taxes were also receivable in it for two months, and various other methods were offered of relieving the community. All the *vellón grueso* thus received was to be melted down, and to make a market for the copper the laws pro-

hibiting its importation, even in the shape of manufactured articles, were to be strictly enforced. It was argued that when this, which through its superabundance had caused so much trouble, was out of the way, there would remain only the *calderilla*, which would all be needed for petty traffic, so that for larger transactions the precious metals would come forth and circulate abundantly at par, compensating the nation for the losses and sacrifices entailed by the measure.

This was a bold attempt in the right direction, but it was too sudden and too severe to be successful. It must have caused abundant ruin and distress, and the clamor for relief must have become irresistible, for in less than five months another edict was issued (November 14th), announcing a complete reversal of the means proposed for attaining the end in view. This time the *vellón grueso* was retained as money and the *calderilla* was proscribed and demonetized on the spot. Those who should register what they held within fifteen days and surrender it within two months were promised the same satisfaction as that offered in the previous decree to the holders of vellón, and any one in whose hands it should be found after sixty days was liable to the penalties for circulating forbidden money. This reduction in the base currency, together with the large amount of the precious metals in the country and the yearly accessions by the fleet, it was argued, deprived any difference in value of all excuse. As this measure was the ultimate remedy whereby to obtain absolute parity between them, any deviation from such equality was declared a species of treason. Any premium or discount, however small, exposed all participating in it, whether as principals or brokers, to confiscation and deprivation of office and of citizenship. A special court was established for the prosecution of such cases, in which the trial was to be secret and the names of the witnesses withheld from the accused. Judges everywhere were ordered to see that prices were reduced by one third, and all outstanding debts and obligations were required to be settled at the same reduction.

This fresh disturbance of all business relations was as fruitless as its predecessors. The *calderilla* thus called in was not melted down but was restamped, and by a decree of October 22, 1654, was received at its old valuation. Large amounts had apparently been retained by the people in spite of the threatened penalties, and this they were told would be receivable for dues to the fisc at one half its nominal value, or might be taken to the mints and by exchanged for half the amount in the restamped coin. Forty days were allowed for this, after which its possession involved confiscation and six years of *presidio*, or galleys.

After this there was a pause in legislation until September 24,

1658, when an attempt was made to unify the minor coinage by withdrawing the *vellón grueso* and substituting a new copper issue of the same weight and nominal value as the *calderilla*, so that there should be but one kind of currency. To check the temptation to import imitations of this, the same savage penalties as before were re-enacted—confiscation and the stake, with the forfeiture of any vessel bringing it. The *vellón grueso*, however, refused to be withdrawn, and on May 6, 1659, a compromise was attempted by reducing it in value one half. Moderate as was this contraction of the currency, it served merely as a prelude for further inflation. Although the Peace of the Pyrenees, in 1659, might be expected to lighten the financial necessities of the state, a *pragmatica* of September 11, 1660, under pretext of providing a currency lighter, easier of transport, and more convenient for use, ordered all the *vellón grueso* to be called in and reworked, so that the marc of copper in place of producing 34 pieces of 2 maravedis should furnish 51 pieces of 4, thus trebling its nominal value. This must have called forth energetic expressions of dissatisfaction, for in less than two months—on October 29th—a new project was announced. The coinage of pure copper was stopped, and in its place a new alloy was ordered containing 20 grains of silver to the marc ($\frac{1}{230}$), to be worked into 51 pieces of 16 maravedis, and smaller coins in proportion. The existing *calderilla* and *vellón grueso* were allowed to remain in circulation, to be gradually worked over into the new coinage as they should reach the treasury. The new issue was styled *moneda de molino de vellón ligado* —mill money alloyed—shortened into *moneda de molino*,* and added to the confusion by furnishing a third debased coinage, for of course the two older ones remained in circulation. The country speedily was flooded with the new currency, and prices began to rise still higher. Some relief was necessary, and, as usual, it was applied in a violent and summary manner. A *pragmatica* of 1664 reduced the value of the new *moneda de molino* by one half —the 16-maravedi piece was to pass for only 8; for thirty days it would be received at the old rate by the treasury in settlement of overdue debts and taxes up to the end of 1662; after thirty days it would be accepted only at fifty per cent of its face, and the Royal Council was vaguely ordered to adopt such measures as it should deem wise to prevent injustice between buyers and sellers, debtors and creditors. As there ought to be only one base-metal currency, moreover, the edict prohibited the further use of the

* It seems to have been not long before this that the mill or machine for stamping was introduced, enabling coins to have a raised and milled edge, to check clipping. In the Indies the primitive *labor de martillo*, or hammering process, was maintained until 1728, when mills were ordered to be erected. Where practicable, these were run with water power; when this was not available, by mules.

calderilla and *véllón grueso*—those coinages which had undergone so many vicissitudes, and which, in spite of prohibitions, persistently continued in circulation. They were a shirt of Nessus, clinging to the victim and impossible to discard.

Again the load became too onerous to be endured, and relief was imperative. The mints were pouring forth the *molino* money; there were quantities of it in circulation of pure copper illegitimately issued, and the land was filled with imitations brought from abroad. To remedy this, a decree of February 10, 1680, orders the simultaneous registration and sequestration of the whole, carefully distinguishing the three varieties. The first, or legitimate alloyed coin, was reduced to one fourth of its existing value—that is, the piece which had been originally issued for 16 maravedis, and had in 1664 been cut down to 8, was now still further diminished to 2; the same was done with the native counterfeits, while the foreign ones were accepted at one eighth of their current value. To soften the blow to the holders the legitimate *molino* was redeemable at the treasury in gold or silver at fifty per cent premium, and was receivable for sixty days for all overdue debts to the fisc up to the end of 1677, while, as a further act of grace, arrearages due up to the end of 1673, amounting to over 12,000,000 ducats, were forgiven.

This measure appears to have been designed as a preliminary to the total extinction of the *molino* money, for it was followed, May 23d, by an elaborate *pragmatica* demonetizing this wholly and forbidding its use, only twenty-four hours being allowed during which it could be spent for the purchase of bread, meat, and wine, and for nothing else. In all these efforts at contraction it was expected that the inflated prices, which were a standing grievance, would collapse with the diminution in the circulating medium, and when this result did not follow with sufficient rapidity, there was no hesitation in fixing a scale of *maxima*, for the transgression of which heavy penalties were threatened. Thus on the present occasion a most elaborate edict was issued, November 27, 1680, consisting of over a hundred folio pages, regulating all dealings. All rents in Madrid are to be reduced to what they had been in 1670, and for buildings of later construction or enlargement the rates are to be determined by the magistrates. Then follows a most extensive list of maximum prices, embracing nearly three thousand items, from raw materials by wholesale to finished products by retail, from wool by the *arroba* to rhubarb by the drachm, and including what a tailor should receive for making a coat and a washerwoman for washing a shirt. Such supervision by the state becomes endless, and a supplementary edict was requisite, May 2, 1681, supplying omissions and making changes. If currency and values were capable

of governmental regulation, it would have been accomplished by Spain.

All this time the prohibited *calderilla* and *vellón grueso* were in circulation, the latter running 74 maravedis to the marc, or about 56 cents of our money to the pound, while copper was worth about 29. The legalized premium on gold and silver was still fifty per cent. Even copper was now becoming scarce under the ceaseless labor of the mints. A proclamation of May 14, 1683, sets forth that it is for the common benefit to have abundance of copper money; and, in order that all the metal in the kingdom may be thus utilized, all pieces of copper brought to the mints will be paid for at the rate of 3½ ryals of vellón for the pound. To prevent its being wasted by consumption in the arts, all coppersmiths are forbidden to manufacture articles of it, or to repair old ones that may be brought to them to be mended. Their shops are to be visited, and their stocks of metal seized and paid for at the above price; inventories of their finished work are to be drawn up, and sixty days allowed for the sale of the articles. Anything concealed is declared to be forfeited, and severe penalties of fine, confiscation, and exile are decreed for evasions or infractions of the order. A false financial system had brought Spain to such a pass that, with the wealth of the Indies pouring into her lap, gold and silver had been driven from circulation, and she was ransacking the shops for scraps of copper to keep her mints busy.

These resources proved insufficient to supply the ever-growing demands of a depreciated currency, and resort was had to remonetizing the *molino* alloyed coinage which had been prohibited in 1680. By an edict of October 9, 1684, it was restored to circulation at a valuation double that which it had borne prior to its demonetization, which would seem to render superfluous an accompanying threat of penalties for its exportation, the same as for gold and silver.

Having thus apparently exhausted the possibilities of copper inflation, attention was turned to gold and silver which had hitherto been but little tampered with. A *pragmatica* of October 14, 1686, ordered a reduction of weight of twenty-five per cent in the silver ryal by working 84 to the marc in place of 67. The existing pesos or pieces of eight were rechristened crowns, and were ordered to pass for ten ryals, and the smaller coins in proportion. This was purely an inflation measure without any view of reducing the discount on vellón, for the fifty per cent premium was ordered to be applicable to the new light-weight silver coins, of which the piece of eight was declared equivalent to twelve ryals vellón, and the old one, now called a crown, to fifteen. No change was made in the weight of the gold coinage, but the value

was raised to correspond, the single doubloon, or gold crown, being declared worth nineteen silver ryals in place of fifteen, and a month later it was further raised to twenty. In this reduction of the standard the interests of the debtor class were tenderly guarded by decreeing that outstanding obligations in gold or silver could be settled on the new basis. Some concession, however, was made on this point where suits arose as to specie lying on deposit or bills of exchange drawn in silver or gold prior to the depreciation, for these were ordered to be paid at the old standard.

The War of Succession, which broke out in 1701, naturally brought large quantities of French silver into Spain. The *quart d'écu* was held for a time to be equivalent to the two-ryal piece, and came to be known as the *peseta* or little peso, but it was pronounced to be inferior in value, and in 1709 its further introduction was prohibited. At the same time the silver standard was reduced to eleven dineros or ·91667 fine in place of the ·925 at which it had stood for centuries. This did not arrest the progressive depreciation of the vellón currency, which in 1718 we find legally recognized in the equivalence of a silver ryal to nearly two ryals vellón, and not long afterward the regular exchange was as one to two. This was allowed by law, and it doubtless was frequently exceeded, for dealers kept the copper coin in bags representing fixed amounts, and those who preferred gold or silver were charged extra for it. This would have worked comparatively little evil if the inferior currency had been confined to the petty traffic for which it was originally designed, but for more than a century it had become the standard of value and the precious metals had been rendered merely a commodity. Thus in the regulations of the mints the salaries are all defined in *reales de vellón* or *escudos de vellón*, and the treasurer has to give security in twenty thousand *ducados de vellón* on unincumbered real estate. It was always necessary, when mentioning a sum, to specify whether it was in *reales de vellón* or *reales de plata*, and with the complexities which crept into the silver coinage we even sometimes find a further definition required, as in such expressions as "*un real de plata provincial, valor de 16 quartos de vellón.*" The evils entailed by the system were freely admitted, but the country had been plunged so long into this financial debauchery that recovery seemed impossible. In 1718 Philip V acknowledged the grave injuries which it inflicted on trade and commerce, but the remedy which he proposed was futile. In 1743 he again deplored the manner in which greed and malice had used the increase of copper money to drive silver from circulation and reduce it to the condition of merchandise. To remedy this he ordered that payments in vellón should not exceed 300 ryals, and

he forbade any charge for exchanging the metals under the same penalties enjoined by the law of November 14, 1652—confiscation and loss of citizenship. It was in vain; the distinction between the coinages was too firmly established, and the tendency was even to increase the premium on the precious metals. In 1772 Charles III, in issuing a new gold coinage, prescribes that the gold crown shall be worth 37½ vellón ryals, and as it was equal only to 16 silver ryals, this shows a premium of over one hundred per cent.

The question of the premium on silver was further complicated by tampering with the silver coinage. In 1726 it was ordered that the *peso* or piece of eight should be counted for 9·5 ryals; the small silver coins of two ryals and less were worked 77 ryals to the marc, in place of the old weight of 67, and only 10 dineros fine in place of 11, thus lowering them to twenty per cent below the standard; and in 1728 the fineness was further reduced to 9 dineros (22 grains), or 0·798, increasing the deficiency to twenty-five per cent. The mintage of the Indies, principally in the larger pieces, was not reduced, and thus there came to be two kinds of silver coinage, known as the *nacional* or heavier, and the *provincial* or lighter. Between these there was a recognized difference of twenty per cent, the *real de plata nacional* being worth 2·5 vellón ryals, or 20 *quartos*, while the *real de plata provincial* was only worth 2 vellón ryals, or 16 *quartos*. There were thus three established currencies of different values, two of silver and one of copper, and for awhile there was a fourth, for we hear, in 1728, of a new coinage popularly known as *Marias*, which is ordered to be demonetized by July 1st next ensuing. The order, as usual, was disregarded, for in 1736 it was repeated, with a prohibition to draw bills of exchange in the forbidden currency.

The depreciation of the ryal has survived, to modern times, the revolution in the currency, which has become decimal, and is modeled on that of France. The *peseta* is the equivalent of the franc, worth approximately twenty cents in our money, and when ryals are quoted they are a fourth of the *peseta*, or five cents, thus being only two fifths of their nominal value in silver. Whether the vellón ryal has ceased to be the standard money of account I can not say, but I happen to have before me a draft drawn through the Bank of Spain, December 17, 1858, in Madrid on Jaen for "*la suma de tres mil reales de vellón en plata ú oro*," showing that accounts were still kept in vellón and that every transaction involved a conversion of this into specie.

There can be no exaggeration in attributing to these perpetual fluctuations in the standard of value a leading part in the industrial and commercial decadence of Spain. During the period we have

traversed, Spain was the chief source through which Europe derived the precious metals, yet it could never retain them, in spite of savage laws prohibiting their export; its people were forced to content themselves with a debased coinage, and at times it could scarce procure enough copper to supply even this. Commercial and industrial enterprise was impossible when no one could know from day to day what was to be the value of the money which was due to him, or in which he was to meet his obligations, and consequently the magnificent resources of the land remained undeveloped, while the rest of western Europe was entering on the modern era of industrialism. Once embarked on such a vicious course, return to a permanent standard was too painful a process to be endured, and the efforts made toward it from time to time only aggravated the trouble by increasing the uncertainty, for the distress which they caused was too acute for even Spanish endurance. Thus it dragged on from century to century, while the wealth of the Indies enriched the nations whose commercial instincts taught them the essential necessity of an unvarying standard of value. This was no new discovery, for the long-enduring prosperity of Florentine manufactures and commerce was largely attributable to the jealous care with which the republic preserved the purity and weight of its coinage, so that the florin became a recognized standard throughout Europe, the honesty of which no one ever questioned. Florence had learned the lesson from the Byzantine Empire, whose historian, Mr. Finlay, asserts that its prolonged duration was greatly owing to the wisdom which preserved its coinage unaltered for eight centuries, so that "the concave gold byzants of Isaac II (1185–1203) are precisely the same weight and value as the solidus of Constantine the Great." With the Latin conquest in 1204, barbaric recklessness was introduced from the West, and successive debasements of the coinage accompanied the decay and extinction of the empire of the Cæsars. Spain affords an exceedingly instructive example of the opposite, inasmuch as its trouble arose from a token currency of small denominations which was incautiously allowed to expand until it dominated the whole financial system, to the exclusion of the precious metals.

THE "Australian Snow Country," as Mr. John Plummer, of Sydney, calls it, includes a region in the neighborhood of Mount Kosciusko and the Munoing Range where fires and blankets are needed, even during the hottest days of that continent of summer torridity. Mount Kosciusko, 7,171 feet high, is the highest peak in Australia, but is remarkably easy of ascent. The climb begins twenty-five miles from the top, and is practicable for a drive all the way. There are no trees within several miles of the top, but gigantic mosses grow there and beautiful flowers.

THE HAWKS OF NEW ENGLAND.

By WILLIAM E. CRAM.

DURING the middle ages, while "the noble sport" of falconry was in vogue, hawks, and to a certain extent all kindred birds of prey, were respected, revered—almost worshiped—contemporary naturalists, and even their successors for many centuries, placing them at the head of their order, much as man is ranked as the head of all mammals. Recently, however, as scientific methods have taken the place of romantic fancies, a change has shown itself, and the whole tribe has been moved down almost to the foot of the list, where in the minds of bird students they occupy a position only a little more dignified than that of the penguins and similar seafowl. Nowadays it is the fashion to speak of them as robbers and butchers, low in their grade of development, and lacking even in intelligence.

Without denying the justice of all this, I must still confess to a strong admiration for them, having always found them more interesting than any other group of birds.

Of course, the literature touching this particular subject is very great, and it is almost a hopeless task to try to write anything new; still, since the favor into which the smaller birds have fallen of late has resulted in a rather undeserved oblivion for the once-honored falcon, it may not be out of place to note anew their varieties and characteristics, since their commonness in this country makes study very easy, while their almost forgotten qualities well repay one for a little attention. In speaking of them I shall not class them in the order assigned by the old naturalists—viz., as long-winged or noble falcons, short-winged hawks, and ignoble kites and buzzards—but according to their size, as they are generally known by farmers and hunters, the bitter enemies that now concede them attention, and take the place of the courtly nobles who treasured them as almost their most precious possessions.

Of the largest hawks, there are quite common with us the rough-legged, the red-shouldered, and the redtail: the first is known as the winter hawk, the others are the hated hen hawks, and are hardly to be distinguished one from another. From April to November they may be seen sailing in wide circles over the woods and pastures, or perched on some dead tree from which they may overlook their hunting grounds.

Redtail is probably the heaviest of all our hawks, and he shows his weight as he flies, while a pretty large branch may be seen to bend if he lights on it. He has a fierce, long-drawn, savage scream, and his tones are usually angry and harsh. Hen

hawks are most abundant during the last part of summer, and at that time if a flock of poultry should stray out into the field a single hawk will sometimes kill two or three of them before they have reached a place of safety.

Although only a buzzard, he kills his prey with a single stroke, like a true falcon, and his capacity is enormous, yet sometimes for weeks together he is content to live entirely on mice and grasshoppers. His color is grayish brown above, and yellowish white beneath, with traces of rusty red on the tail feathers, which, when the bird is in full plumage, become wholly red with a black band near the tip.

But trying to know hawks by their colors is uncertain work at best, as members of most species change their entire coloring

RED-TAILED HAWK.

at least once in their lifetime. These changes are popularly ascribed to age, birds in full plumage being spoken of as old ones, though they have always seemed to me to depend more on the general vigor of the bird, as it is not uncommon to find specimens showing every mark of great age, with stiff joints and beaks and claws worn blunt, in precisely the same attire as when they left the nest, while those in full plumage, as far as my observation goes, are never very old, and are always in excellent condition.

The red-shouldered hawk is smaller and more lightly built than his cousin, and he has a longer tail. In full plumage he is rich brown on the back, with wings and tail barred with black and white, and chestnut-colored shoulder patches. Beneath he is dull red, more or less barred and spotted with white. Young birds are much the same color as redtailed hawks. This bird

keeps more to the woods than the redtail, and is much less destructive; his cries are shorter, shriller, and less savage, and his general disposition is milder. In the spring they are especially noisy, and then several pairs may sometimes be seen circling together high in air, all whistling and screaming at the same time.

RED-SHOULDERED HAWK.

Occasionally a pair will remain all winter, and during this season they will keep to the thickest parts of the woods and loaf about open springs, feeding on such half-dormant frogs as rise to the surface of the water. They never appear to suffer from want of food, however, as all those I have killed in winter had a thick layer of fat under the skin.

Although the rough-legged hawk is usually spoken of as rare in this part of the country, they seem to be common enough here in southeastern New Hampshire, at certain seasons at least; and during the Indian-summer weather that comes just before winter sets in, I can at almost any time find one or more without the least trouble. Perhaps it is because they are here at a season when other birds—and hawks in particular—are most conspicuous by their absence that this species is so well known; still, there seems to be something different in their method of flight and ways in general. One peculiarity the rough-legged hawk shares with the little sparrow hawk—that of hanging like a wind-hover in midair, head to the wind, with dangling legs, his keen eyes watching the grass beneath for any sign of a mouse. With a continual rolling flap of the wings he holds himself, hour after hour, over precisely the same spot. At the first glimpse of a mouse he goes down with a perpendicular rush like a falcon, and flounders and flaps around until he has the little victim in his claws.

Judging from my own experience I should consider this the most intelligent of hawks. With the utmost caution I find it almost impossible to approach within two hundred yards when I

have a gun, even in the best of cover, and yet they will sit on the trees by the roadside and let carriages pass almost under them, or fly back and forth within fifty yards of a team. Apparently they have less fear of skaters than of pedestrians, probably having learned from experience that any one on skates is hardly likely to prove dangerous. They seem to see every one and everything within a radius of a quarter of a mile, and never lose sight of one for a moment. Most of those that I see are dark brown, with a dark belt underneath, and the base of the tail is usually white. Others are dark brown above and nearly black beneath, the tail white with bands of black and gray near the tip. The colors vary, however, from dark to light, a few being quite black, with white spots on the tail and under the wings.

They are seldom seen here in midwinter, but when the ice breaks up in the spring they pass over on their way north, and sometimes stop for a few days in the meadows.

Another large hawk, whose swiftness and courage made him a great favorite with the old falconers, is the goshawk, but as

ROUGH LEGGED HAWK.

most of them are colored like some of the other large hawks, and are, moreover, extremely shy, keeping always to the dark, evergreen woods, it is sometimes hard to be certain about having seen one. This species could hardly be called common, though occasionally in August birds that I take to be goshawks are very

abundant. I am not absolutely certain, however, as to the species.

One August afternoon I heard an angry croaking that seemed to issue from the top of a large oak. As I approached a goshawk waddled out along a horizontal branch, and on another that extended parallel with the first and only a few inches below marched a crow, keeping directly under the hawk and striking savagely at his feet. Both kept their wings tightly closed, and neither seemed in the least excited. I do not know how the quarrel ended, for presently both flew to another part of the woods to argue the matter away from human intelligence. There seems to be a continual feud between the crows and all kinds of hawks, and some of the disputes that arise are humorous in the extreme. I once saw a sharp-shinned hawk that insisted on flying south in company with a flock of crows. To be sure, if he flew at the same height as they did, he would have to fly with them, for the sky was full of crows at the time, all going in the same direction; still, he might have risen above them or kept down nearer to the tops of the trees, but evidently he didn't choose to. Every time a crow dashed at him he would sweep down out of their ranks, only to join them a few yards farther on, and when, miles away, they were only just visible through my glass, the dispute seemed still in progress.

GOSHAWK.

In full plumage the goshawk is bluish-slate color, and differs from the other large hawks in having shorter wings, longer tail, and yellow or orange-colored eyes.

When flying, the marsh hawk has the appearance of being a large bird, but in weight he would be classed among the smaller hawks. A lean-bodied, loose-jointed, long-limbed bird, he sails along close to the grass, carefully beating over ever foot of ground in his day's hunt. The small birds seem to realize that it is useless to try to escape as they do from other hawks by hiding in the tall grass, and as soon as one appears you may see meadowlarks, blackbirds, reedbirds, and sparrows rise in clouds and fly for the nearest woods for protection. When there is a flight of

warblers, and the treetops are alive with these brilliantly colored little fellows, the marsh hawks follow them and rise and dip among the branches like swallows in a listless, careless manner, striking with their long legs at whatever bird happens to be nearest. They are very methodical in their way of hunting, and day after day follow the same course, flapping back to the nest whenever successful. They nest on the ground in a swamp or brier patch, and the young remain hidden about in the bushes, where they are fed by the parents for months after they are able to fly. All their cries are rather faint and hysterical, and they always seem to be somewhat weak-minded; still, they show considerable intelligence at times, and appear to distinguish between persons. I remember one pair that became quite friendly, and, when I visited their nest, would light near me or hover close over my head, even when I carried a gun; but a neighbor of mine, who accused them of stealing his chickens, complained that they would not come within gunshot, even when he thought himself well hidden. In color they vary from pale, bluish gray to dark brown above, and from white to chestnut red underneath, and are easily known by the large white patch on the back. They are abundant from the last of March to November.

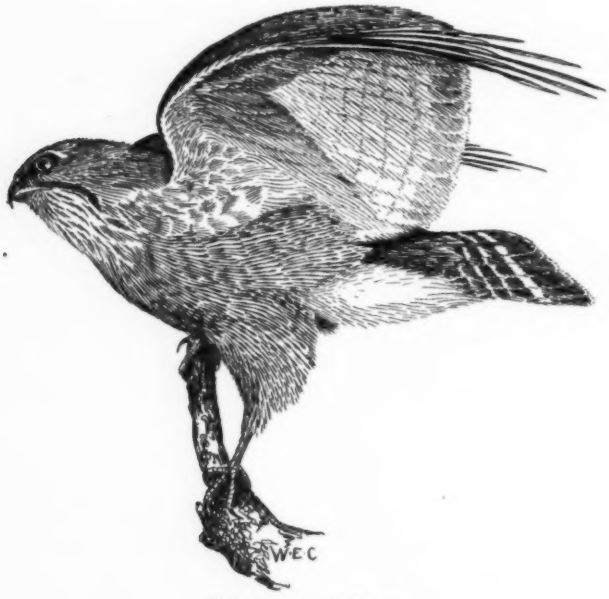
For medium-sized hawks we have the peregrine falcon, Cooper's hawk, and the broad-winged hawk. The peregrine falcon is a rather uncommon bird. I occasionally see them in the spring, but not often. This is the falcon *par excellence* of the older writers, and is said to be the most dashingly courageous of all hawks.

MARSH HAWK.

The broad-winged hawk is also rare, but less so than the last; he looks like a heavy, owlish fellow, with broad, rounded wings, and a short tail that seems to be inserted between them. He is usually seen in frosty October weather, and spends most of his time in the woods. Cooper's hawk, or the chicken hawk, is plentiful enough: a slender, compactly built bird, with a long tail, short wings, and fierce, yellow eyes, steely blue or rich brown on the back, and white-barred or streaked with reddish on the breast. He flies with tremendous swiftness, and doesn't seem afraid to tackle anything.

This is probably the most destructive hawk we have, a nest with young birds usually containing remnants of partridges, chickens, and perhaps a dozen kinds of small birds, but very seldom any signs of mice or insects. When together, these chicken hawks are always quarreling with each other, and pairs separate about as soon as the young birds are able to take care of themselves. Their scream is, I think, the most petulant, angry, ear-piercing note to be heard in the woods.

The three small hawks are the merlin, the sharp-shinned, and the sparrow hawk. The first two are commonly called pigeon



BROAD-WINGED HAWK.

hawks. Sharp-shinned is almost exactly like a small Cooper's hawk, but not so compactly built; in disposition he is quite as bad, and makes up in general recklessness what he lacks in size; he is less businesslike, however, and flies through the woods in a crazy, erratic sort of way, apparently with no particular object in view, striking savagely at every living thing he sees, though seldom following a bird if he misses it the first time. These birds have a curious way when alone of darting back and forth between two branches, striking with their claws at some particular knot or leaf, as if for practice, and then performing a most indescribable kind of war dance. Being especially fond of young chickens, they will come day after day to the same yard, and are only too often successful in their hunting. At such times it is almost impossible to shoot them, as they come with a rush and are gone,

sneaking from orchard to orchard, and you have to guess at their whereabouts from the cries of the small birds that have nests in the neighborhood. A colony of swallows, however, makes an excellent pack of sky hounds to hunt them with, as they keep directly over the hawk, and by watching their movements you may judge what direction to take in order to head him off. Even if you get a good shot at him you may call yourself lucky if you succeed in bringing him down, for he is harder to hit than snipe or woodcock, and is rarely captured until fairly riddled with shot.

Merlins are solid, muscular, beautiful little birds, with close-fitting, dark-colored plumage. They are never very numerous, except in the fall, when they come in flights, and are most abundant near the seacoast and salt marshes. They fly swiftly and steadily, seldom changing their course, and as sure as one of them starts in pursuit of a bird that bird is doomed, for the merlin seldom gives up the chase.

He is not a difficult bird to shoot, for, though tenacious of life, his flight is steady, and, as a general thing, on being hit by a shot, he turns and flies back in the direction whence he came, giving the sportsman a second chance.

In my opinion, the sparrow hawk is the handsomest of his race; his back is bright, golden cinnamon, his wings steely blue and jet black, and his tail chestnut, with a broad black band; his breast is beautifully marked with chainlike patterns of black spots. His mate is chestnut above, banded with black. Unlike other hawks, the plumage of these birds does not vary with age. They usually make their appearance in some still, cloudy day, about the last of March, and take up their position in the meadows; from then until September they are always to be seen either perched on the topmost twig of some tall elm or hovering in the air on the lookout for prey. Their nest is in some hollow tree or deserted woodpecker's hole, or even a last year's crow's nest. I have often tried to account for the seemingly friendly relations existing between the sparrow hawks and golden-winged woodpeckers; both frequently occupy holes in the same branch, and sit side by side on top of some tall stub without the least sign of disagreement, although, unless I am very much mistaken, the sparrow hawk often attacks larger birds, and might easily carry off the young ones when the old birds were absent.

About the last of June the young hawks are ready to fly, and at once betake themselves to the nearest thick treetop, preferring an evergreen if possible. They appear to enjoy the change from their former stuffy apartments immensely, and preen their feathers in the bright sunlight, each waiting patiently its turn to be fed by the parents, who are chasing the half-fledged blackbirds and sparrows about the meadows, or darting after grasshoppers

and locusts in the grass. At the first cry of warning the youngsters scramble down into the thick foliage, and hide there as skillfully as young owls. At first they have no especial fear of man, and sometimes on approaching them I have seen the old birds

COOPER'S HAWK.

deliberately knock them off their perch and compel them to fly, driving them into the pines for safety.

I once took a hawk of this kind from the nest when only a few days old, and brought him up according to the rules most approved by the old falconers. He was never confined in any way, and as soon as he had learned to fly had the run of the entire place. His favorite haunt was a series of gutters under the eaves, where he would spend hours at a time hunting for spiders or digging the wasps' nests to pieces for the larvæ. When spoken to at such times he would look out over the edge of the gutter, with his head on one side, and answer with soft, chattering cries, and immediately go back to his work. Let no one make the mistake of thinking that the loud screaming or whistling of hawks is their usual voice, although it is the only one easily heard at the distance hawks usually insist on keeping from the observer. One has only to watch a pair of hawks of any kind close at hand, to learn that probably nine tenths of the cries uttered by them in the course of a day are either low and guttural or soft and almost musical. But it was not until I had had one about me for an entire summer that I realized what an almost limitless variety of

notes he had at his command. Sweepstakes, as we named him, would sit on my shoulder or the rim of my hat, and chatter away with so much expression that it seemed the worst kind of stupidity on my part not to be able to understand everything he said. When he had gained the full strength of his wings he would come flying to me for protection from a furious mob of small birds which he had exasperated by his bungling attempts at hunting, and alighting on the rim of my hat go scrambling round and round it with a great rustling and scratching of his claws. When perched on any one's wrist or finger, he was always careful not to let his claws prick the skin, and was more thoughtful about such matters than the best-natured kitten in the world. He was especially fond of being stroked with the wing feather of some large bird, and was always uneasy if any of his own feathers were ruffled or misplaced. He would almost always come when called, even though not in the least hungry. Sometimes if he saw Jack, the white bull terrier, going about with a bone in his mouth, he would light on the bone and ride

SPARROW HAWK.

there until he had eaten what he wanted. If it took him some time to get enough, Jack, who was a most exemplary gentleman, would drop the bone, and lying down beside it quietly wait for his very good friend to finish. But his very fearlessness proved his destruction, for he got into the way of flying across the pastures to a farmhouse half a mile away, and was shot, to the bitter regret of all who had known him.

The next season I took a female sparrow hawk from the nest, when nearly grown, but she was never quite as familiar as Sweepstakes, and in a few days ran or rather flew away. If she had gone north toward the meadows, she would probably have found her parents, at that time engaged in teaching her brothers and sisters the rudiments of hunting, and would probably never have returned. Instead of this she took the opposite direction, and in a few days came back with a tremendous appetite, hungrily eating everything that was given her. When haying time came on she would follow about the field, lighting on rake handles or shoulders, or even the cart, when she was not feeding on grasshoppers till she could hardly fly. Toward the end of summer she would be gone for days on hunting excursions, her ability in this direction having increased, but on her return would be as familiar as ever.

One day, however, she appeared nervous and frightened, and on taking her in my hand I noticed that shot had cut through her wing feathers, and those on her breast were rumpled and bloody. Suddenly she caught sight of some one in the road more than a hundred yards away, and was instantly in the air, soaring out over the fields and up toward the clouds until almost out of sight. She seldom came about the house after that, and though when I saw her in the meadows was apparently not afraid, she yet refused to come at my call. Early the next spring a female sparrow hawk lighted on the roof of the barn, and at one time seemed to show signs of coming down to me, but evidently thought better of it, and flew off toward the north. Perhaps it was only a wild hawk; still, I prefer to think that she is still alive, and has escaped those who shoot hawks only to obtain the bounty offered for their scalps by the State.

WHILE traveling in the Balearic Islands, M. Gaston Vuiller, passing through a gorge in Minorca, found the road barred by extemporized stone walls, tree trunks, and all sorts of loose obstacles, while the foliage above was hung "with colored ribbons and garlands of flowers and fruit, like the route of a triumphal procession." This was in preparation for a wedding festival, and in obedience to a custom of placing every possible obstacle in the way of brides and bridegrooms in order to remind them how difficult is the path to happiness, while the festoons above express the good wishes of the people. The proper attention for a lover on this island to pay his sweetheart is "to steal silently upon her from behind and suddenly to discharge his musket into the ground at her feet, and a well-brought-up girl never winces under the trial." Suitors announce their good feeling for the family by discharging a musket in the sitting room after spending the evening with them, but before saying "good night." If the "good night" has been said, the firing is held to signify a challenge to a rival.

PRINCIPLES OF TAXATION.

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X.—NOMENCLATURE AND FORMS OF TAXATION.

(*Continued from page 480.*)

"REAL" AND PERSONAL TAXES.—Direct taxes are also spoken of, and in fact, classified as *real* and *personal* taxes. "*Real*" taxes (Latin *res*, thing), or taxes on realty, as is the general expression, are taxes on property—generally on things naturally characterized by immobility—without reference to the pecuniary condition of the owner, and hence without taking his debts into account. A tax on land or real estate—houses and land—is a typical tax on realty; and a tax legally assessed upon such property rests, or is a lien upon it, irrespective of its ownership.

Business taxes are regarded as real taxes, as they are taxes on pursuits or occupations rather than on persons. The same is true of taxes on capital and the rental value of land or buildings.* The restriction on the levy of direct taxation imposed by the Constitution of the United States on the Federal Government does not apply to the States.

Personal taxes are taxes on persons. A poll or "capitation" or "head" tax, implying a uniform payment from every poll or head of some portion or all the population of the State, would be a typical personal tax. Strictly speaking, therefore, a personal tax can be no other than a poll tax levied under the above conditions. What are usually called personal taxes are taxes assessed or rated to a person, not as in the case of a poll tax because he is a person or citizen, but in virtue of the movable property—furniture, clothing, vessels, carriages, animals, money at interest, stocks in corporations, bonds, or negotiable instruments and the like belonging to him. It is the individual that the law regards as the objective rather than his personal property—which may not be tangible or visible—on enforcing the tax; the property being resorted to for the purpose of ascertaining the amount of tax which its owner should pay. An income tax is regarded as a personal tax because it is assessed on the income that gathers about a person irrespective of its source—rents, interest, profits, salaries, and the like. A tax on land is a tax on realty, while a tax on a mortgage is a personal tax, which is equivalent to affirm-

* "Real estate for the purpose of taxation shall include all lands within this State, and all buildings or other things erected on or affixed to the same."—*Statutes of Massachusetts.*

ing that the former is a *thing*, while the latter is only the representation or shadow of the thing.

In levying taxes on realty the owner, as a rule, is not allowed to offset or reduce its valuation by the amount of his outstanding indebtedness; but in the case of the taxation of personal property such an offset is generally permitted, on the ground that a man should be taxed only upon what he *owns* and not upon what he *owes;* and even when not allowed by law, the circumstance of indebtedness is almost always taken advantage of by persons assessed, for reducing valuation in making returns to the tax officials of the value of their property. In assessing an income tax a deduction is allowed for interest paid on mortgages, and such business expenses as lessen income. Personal expenses, as house rent, cost of living, and the like, can not, on the other hand, be properly deducted from income before it is taxed, because income is sought for and exists for the purpose of defraying such expenditures. By the income-tax law of the United States, enacted in 1865, and also in 1894, deductions were allowed from the amount of taxable income, of all taxes paid within the year, of all interest paid on indebtedness, and the rent or rental value of any homestead actually occupied by the taxpayer.

One of the most curious features of recent tax experiences in the United States has been the extent to which this practice, or right of reducing valuations of personal property for taxation by debts, has been made the opportunity for evading taxation. Thus, by the very structure of the Federal Government, its various instrumentalities, as heretofore explained,* are necessarily exempted from all taxation by the States of the Federal Union. Recognizing this, it has been the habit of individuals to effect *credit* purchases to a greater or less amount of United States securities a short time previous to the time fixed for tax returns or valuation, and then offsetting *the debts* thus incurred against valuation, evade the taxation on their personal property to which they would otherwise be subjected.† And for such moral wrong there would appear to be no legal remedy on the part of the State, except by the commission of a greater wrong—namely, the prohibition of the offsetting of all debts in tax valuations; or, what is

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* See Popular Science Monthly, vol. l, No. 3, p. 289; vol. l, No. 4, p. 468.

† When the Federal Government effected in November, 1894, a loan for $50,000,000, a premium was paid on no inconsiderable amount for the privilege of purchase, or investment, so large as to net to the purchaser an abnormally low rate of interest—2·5 per centum. The explanation of this action was that, apart from the recognized value of an unquestionable security, the investment carried with it an exemption from a national income tax of two per cent, as well as from State and municipal taxation—so that the rate of interest accruing to the purchaser was not as low as it might have seemed to be, and by the holders and managers of trust properties was generally regarded as satisfactory.

the same thing, the imposing of a discriminating burden of taxation upon persons who, for any cause, may be in debt—a denial of equity which public sentiment in every free country will not long tolerate. A further proof and illustration of this averment may be found in the fact that years ago the Constitution of Ohio provided that credits, or evidences of indebtedness, should be subject to taxation by a uniform rule; and the Supreme Court of Ohio subsequently decided that this did not allow any offset of debts owed against credits owned. But popular opinion was so adverse that by common consent this clause of the Constitution, as interpreted by the court, was entirely disregarded in making up tax valuations.

In old English history the division of property into *real* and *personal* was wholly unknown; and all laws regulating this species of property, with a view to taxation or inheritance, are of comparatively modern origin.* It is also interesting to note that probably full one fourth of all the so-called personal property of this country—namely, all railroad, steamship, telegraph, telephone securities—did not have an existence fifty years ago.

As is the case with direct and indirect taxes, the line of demarcation between real and personal property, and consequently between real and personal taxes, is very indefinite, and some very nice and curious points in connection therewith have been established by usages, or court decisions. Thus an apple on the tree is real estate, but when fallen upon the ground it becomes personal property. Running water accumulated in a pond is real estate, though the owner is not permitted to invest it with the peculiar attribute of real estate—namely, stability—by permanently arresting its flow. In some States the engines, water wheels, shafting, and even belts of factories are real estate, while looms and lathes are personal property. Stone in the quarry is real estate, but when thrown out by a blast and made ready for market it becomes personal property. Hop-poles, not standing, have been

* The first authorization of local taxation in England was for the maintenance of the poor, and occurred in the reign of Elizabeth. At that time it seems to have been assumed that there was no personal property in the kingdom capable of being assessed, and that real property was alone valuable property. Hence it was enacted (43 Elizabeth, cap. 2) that overseers should be appointed who were to raise, by taxation of every inhabitant, parson, "and of every occupier of lands, houses, tithes impropriate, propriations of tithes, coal mines, or salable underwoods in the said parish," moneys for the relief of the poor. No mention was made of personal property, and it is probable that every kind of property then known was mentioned in the act. When fresh burdens were necessary the principle adopted by the act of Elizabeth was continued, without much inquiry or opposition, and owners of personalty have remained exempt from taxation, although personal property has gone on increasing until its value has become much greater than all the real property of the kingdom.

decided to be real estate, but wood cut and corded for sale is personal property. A statue exhibited for sale in a workshop is personal property, but when placed upon a permanent foundation (although not fastened to it), as an ornament in front of a house, has been held to be a part of the realty. Chairs in a theater and screwed to the floor, as they can not stand alone, are considered a part of the realty; but gas fixtures and mirrors, made to order for the house, and attached to the freehold, but removable without injury thereto, are not deemed a part of the realty. Before emancipation in the United States, slaves, which by the Federal Constitution were recognized as persons, were in several of the States declared by law to be real estate;* and in one State of the Union, Wisconsin, the one species of property which is especially typical of mobility, and is of no value apart from its capability of motion, namely, the rolling stock of railroads, has been by law made real estate. Shares in the national debt of France, as well as stock on the bank of France—instrumentalities which in the United States would be regarded as personal property in its most typical form—may by French law be made real estate, and as such be administered on.

Some years ago the following curious experience occurred in one of the New England States: A person rented a farm, and on the expiration of his lease attempted to remove from the estate the manure which had accumulated during his holding, assuming that he had the right to it as personal property. The owner of the farm, on the other hand, forbade the removal of the manure, on the ground that it was real estate, and so a part of the farm. The case found its way into the courts, and on its trial the lessee and defendant who appeared for himself, attempted to substantiate the legality of his proceedings in the following manner: Addressing the judge after the facts in the case had been established, he asked, "Was the hay in the barn personal property?" *Judge*: "Certainly." *Lessee*: "Were the horses and cattle personal property?" *Judge*: "Without dispute." *Lessee*: "Then will your Honor please to tell me how personal property can eat personal property and produce (dung) real estate?" The decision was nevertheless in favor of the owner of the farm, or the plaintiff. Subsequently the courts of New York decided that manure accumulated in connection with a livery stable, not being an agricultural product pertaining to a farm, was not real estate but personal property.

In a case in the State of Tennessee, where a person who had entered a neighbor's field and removed corn on the stalk was

* In American colonial days slaves were regarded as belonging to the land, and figured in tax valuations as real property.

prosecuted for larceny, the court held that the offense was not larceny, which is the unlawful taking and carrying away of personal property, but trespass, inasmuch as the corn not severed from the ground was real estate, but would have been larceny if the corn had been gathered or disconnected from the ground previous to its taking. Thereupon a bill was introduced into the Legislature of Tennessee to make it a felony to steal corn from a field under any circumstances.

From these illustrations it seems obvious that the distinction between real and personal property and real and personal taxes is, to a very great extent, an artificial and not a natural distinction.

The following are some of the other terms used to designate particular forms of taxation, the meaning and technical application of which may not be readily apparent:

A *franchise tax* is a tax on a franchise, or on a right granted by a State to a corporation or association to exercise certain privileges. In fact, a franchise *is a privilege*, and in most cases it is an exclusive privilege, and has an actual value largely disproportionate to the amount of capital invested by the company or corporation upon which it has been conferred.* It has been held by the courts that a franchise tax is not a tax on capital or on real estate, but on privilege, and does not exclude additional taxation on any property covered by the franchise.

The terms *imposts* and "*customs*" (Latin "*consuitudines*") are generally understood to mean indirect taxes on the importation of commodities, while the term *duty* is more properly applied to a tax upon exports.

The origin of all these terms is obscure and involves some interesting features in English history. It appears certain that they were in the first instance applied to exactions on trade generally, and not, as was finally the case, on imports and exports exclusively, and were in use before indirect taxes on personal

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* The following is a case in point, derived from actual experience: A street railway company in a city of the United States reported the gross earnings of the corporation for 1891 at $1,188,000. Its net earnings were $400,000, or nearly six per cent on a capitalization of $7,000,000. Its city property tax was only $11,000, or $2.10 on $500,000. It is evident, therefore, that the value of the capital of this corporation was due largely to the value of its franchise.

The value of a franchise is an eminently proper subject for taxation, though it is not commonly so regarded. The Supreme Court of Pennsylvania, in a recent case (1894), has held that under the laws of that State it was proper and lawful in ascertaining the actual value of the capital stock of a corporation (Susquehanna and Schuylkill Railroad Company) to take into consideration, as affecting that value, the franchises of the company. Franchises conferred by Congress upon a corporation created by it, to be exercised within a State, can not be subject to taxation by the State without the consent of Congress.—*California vs. Central Pacific Railroad Company.*

property were recognized in England. At the outset and for a long period they were also not regarded in the light of taxes, but rather as dues personal to the sovereign, which he had the right to regulate and collect independent of any statute, and which carried with it the further right to restrain at pleasure the import or export of any commodity.* Thus, until the reign of Edward II (1272–1307) the right to tax the export of wool was exclusively a royal privilege; and the enactment of a statute by Parliament in 1275, limiting the amount that the king could take in respect to the export of wool, skins, and leather—but not denying the privilege—is regarded as the first legal foundation in England of the customs revenue. The controversy between the king and Parliament over customs duties went on, however, with varying phases until finally settled in 1682; and from these circumstances, and also from the fact that customs and duties are unseen by those who finally bear their burden because they are embodied in the prices of commodities, has possibly come about the curious idea that tariffs, or taxes on imports, are not taxes on any one or are any burden on property, but rather some sort of a business contrivance for the raising of revenue, and, if they are taxes at all, then that the foreigner pays them.

The term *impost* is a general expression for any tax, duty, or tribute, but is seldom now applied to any but indirect taxes on imports.

The term *excise*, though used in the Constitution of the United States, is now almost entirely restricted in use to the tax system of Great Britain; and even there has acquired a far different meaning and application from what it possessed originally. Thus the term was first applied in England to taxes on manufactured commodities produced and consumed in the kingdom, as beer, cider, soap, glass, paper, and the like, and in contradistinction to duties or customs on commodities of foreign manufacture and importation; and this distinction is still officially recognized in the fact that special care has always been taken in all British legislation on this subject to make the excise tax as nearly equal

* It is a curious fact that the old idea that imposts and customs, or the right to impose exactions on trade, were, when first imposed, not regarded in the light of taxes but as dues personal to the sovereign, which he had the right to regulate and collect independent of any statute, has recently found reassertion and indorsement in the United States Senate by a leading member of that body from New England, that he did not regard the levying of imposts or customs dues on imported commodities as in the nature of taxes; for, if such levies on trade are not taxes, they are simply exactions of a despotic form of government, represented immaterially either by one man or a collection of men, and for whom or for which no rightful claim of representing or being a government by the people or for the people can be preferred.

as possible to the customs imposed on the same kind of imported commodities. The term is supposed to find its origin also in the circumstance that it was originally the practice to cut off, or "excise," portions of the goods assessed, and take them away in payment of the tax in kind. The first attempt to impose an excise tax in England was in 1525, and failed, as both Houses of Parliament concurred in opinion that it was unconstitutional. After the Restoration, or under Charles II, the attempt was successfully renewed, and the taxes under it were very curiously divided into two classes, and the receipts from the same made personal to the crown—namely, the *hereditary* excise, so called because granted to the crown forever in consideration or recompense for the abandonment by the crown of certain perquisites and privileges; and the *temporary* excise, the receipts of which were only granted to the sovereign for life. The tax was, however, always unpopular in England, being regarded as contrary to the spirit and principles of a just government, and on the accession of William and Mary it was greatly modified and reduced; and it is somewhat curious that a term having such an origin and history should have found a place in the Federal Constitution and be thus recognized as a legitimate form of taxation under a free government. In Great Britain at the present time the only commodities on which taxes designated as *excise* are assessed are spirits, malt, fermented liquors, and chicory, or other substitutes for coffee. But in addition the British system classifies under the head of *excise* its taxes on railways and a few other minor subjects.

The late United States Justice Miller defined an excise tax as "one which is assessed upon some article of property or money or something which is exhausted in the use. It is one which from its essence and nature must be paid in fact by the buyer, or the last man who buys or uses the property, because, whoever has it at the time when the tax is levied upon it adds that amount to the selling price when he comes to dispose of it until the property is consumed. It is a tax upon consumption." (Lectures on the Constitution of the United States, p. 238.)*

In the United States all Federal taxes that are not levied under the tariff and navigation laws are classified under the general designation of "internal revenue taxes."

The term *toll*, formerly in extensive use, and signifying duties on imports and exports, is now nearly obsolete, and restricted

* "What is the natural and common or technical or appropriate meaning of the words duty and excise it is not easy to ascertain. They present no clear and precise ideas to the mind. Different persons will annex different significations to the terms."—*Paterson, J., Hylton vs. U. S., 3 Dallas, 171, 176.*

almost exclusively in meaning to the charges for permission to pass over bridges, ferries, and roads (turnpikes) owned by the parties imposing them. The courts have held that railroad fares can not be regarded as tolls.

A word in very common use in English history, especially when reference is made to fiscal topics, is that of *subsidy*; but its former and present signification are very different. Under the earlier English kings, when the inadequacy of the hereditary or peculiar revenues of the crown to defray its expenditures compelled the monarch to ask pecuniary aid of his subjects, the grants that were made were known as "*tenths*," "*fifteenths*," or the like, according as the exaction of such percentages of certain properties were authorized, and also as "subsidies" and "benevolences." The peculiarity of all such grants was that they were always special and extraordinary, and had no place in any regular system of taxation. Thus, of the reign of Henry VIII it is recorded that Parliament granted subsidies occasionally, but the king, having found a readier way of obtaining money, did not need them—the readier way having been the confiscation of all the property of the religious houses, which included more than half of all the land of the kingdom; and of Elizabeth, that during the forty-five years of her reign Parliament granted twenty subsidies and thirty-nine fifteenths, the balance of needed supplies being obtained from crown lands—as the duchy of Lancaster—and other hereditary revenues. Under the Commonwealth regular taxes on lands and other forms of property were for the first time instituted in England, and these proved so productive that the old methods of percentages, subsidies, and benevolences were discontinued, and with their nomenclature disappeared from English fiscal history.

At the present time the term *subsidy*, in place of designating as formerly a grant obtained by the Government from private interests, has come to mean a grant obtained from the Government, in aid of private enterprises which it is claimed should be encouraged by the state in the interest of the general public, as, for example, the fostering of shipbuilding and ship-using, and the cultivation and manufacture of certain commodities. But this modern use of the word "subsidy" can not, it is said, be referred back to any earlier period than the year 1840.

Of the many other terms and words used in connection with the subject of taxation, there are very few that seem to require special explanation, and the majority of these, although formerly in extensive use, have now become obsolete and passed into history—as, for example, *gabelle*, the term given in France to the tax on salt; *corvée*, a compulsory contribution of labor; and *taille*, or *taillage*, a tax on the supposed profits of agriculturists, and the

like. The characteristic of almost all modern *tax* words or terms is indefiniteness; and probably in no other department of knowledge is there such a lack of exactness in respect to definitions. This to a student may seem at first to be a factor of no little embarrassment, and as assimilating him to the condition of the man who couldn't see the forest because of the multitude of trees; but with the exception of the definitions of *tax* and *taxation*, this condition of affairs really constitutes no obstacle in the way of clearly reasoning and determining as to what should be the fundamental principles of taxation.

THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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VIII.—THE BASQUES.

THE Basques, or *Euskaldunak*, as they call themselves, on account of the primitive character of their institutions, but more particularly because of the archaic features of their language, have long attracted the attention of ethnologists. Few writers on European travel have been able to keep their hands off this interesting people. Owing to the difficulty of obtaining information from the original Basque sources, a wide range of speculation has been offered for cultivation. Interest for a long time mainly centered in the language; the physical characteristics were largely neglected. The last ten years have, however, witnessed a remarkable change in this respect. A series of brilliant investigations has been offered to science, based almost entirely upon the study of the living population. As a consequence, this people has within a decade emerged from the hazy domain of romance into the clear light of scientific knowledge. Much yet remains to be accomplished; but enough is definitely known to warrant many conclusions both as to their physical origin and ethnic affinities.*

* The best modern authorities on the Basques are Broca, Sur l'origine et la répartition de la langue Basque. Revue d'Anthropologie, series i, iv, 1875, pp. 1–53; R. Collignon, Anthropologie du sud-ouest de la France, Mémoires de la Société d'Anthropologie, series iii, i, 1895, fasc. 4; De Aranzadi y Unamuno, El Pueblo Euskalduna, San Sebastian 1889; Hoyos Sainz and De Aranzadi, Un Avance à la antropología de España, Madrid, 1892; Oloriz Distribución geográfica del índice cefálico en España, Madrid, 1894; and ibid., La talla

Thirty years ago estimates of the number of people speaking the Basque language or *Euskara* ran all the way from four to seven hundred thousand. Probability pointed to about a round half million, which has perhaps become six hundred thousand to-day; although large numbers have emigrated of recent years to South America, and the rate of increase in France, at least, is very slow. About four fifths of these are found in the Spanish provinces of Vizcaya (Biscay), Navarra, Guipuzcoa, and Alava,

at the western extreme of the Pyrenean frontier and along the coast. (See map page 632.) The remainder occupy the south-western third of the department of Basses-Pyrénées over the mountains in France. The whole territory covered is merely a spot on the European map. It is by quality, therefore, and not in virtue either of numbers or territorial extension, that these people merit our attention. In the preceding paper we aimed to

umana en España, Madrid, 1896. Dr. De Aranzadi has also published interesting material in the Basque journal, Euskal-Erria, vol. xxxv, 1896, entitled Consideraciones acerca de la raza Basca. For ethnography the older standard work is by T. F. Bladé, Étude sur l'origine des Basques, Paris, 1869. The works of Webster, Dawkins, Monteiro, and others are of course superseded by the recent and brilliant studies above outlined.

identify the oldest living population in Europe—a direct heritage from prehistoric times. We found it to lie about the city of Périgueux, shown on our map (page 632). Here, less than two hundred miles to the southwest, is probably the most primitive spoken language on the continent. Is there any connection discoverable between the two? Whence did they come? Why are they thus separated? Which of the two has migrated? Or have they each persisted in entire independence of the other? Or were they never united at all? Such are some of the pertinent questions which we have to answer.

These people derive a romantic interest from the persistency with which, both in France and Spain, they have maintained until the last decade their peculiar political organization; despite all attempts of the French and Spanish sovereigns through centuries to reduce them to submission. Their political institutions were ideally democratic, worthy of the enthusiasm bestowed by the late Mr. Freeman upon the Swiss folk-moot. In Vizcaya, for example, sovereignty was vested in a biennial assembly of chosen deputies, who sat on stone benches in the open air under an ancestral oak tree in the village of Guernica. This tree was the emblem of their liberties. A scion of the parent oak was always kept growing near by, in case the old tree should die. These Basques acknowledged no political sovereign; they insisted upon complete personal independence for every man; they were all absolutely equal before their own law; they upheld one another in exercising the right of self-defense against any outside authority, ecclesiastical, political, or other; they were entitled to bear arms at all times by law anywhere in Spain; they were free from all taxation save for their own local needs, and from all foreign military service: and in virtue of this liberty they were accorded throughout Spain the rank and privileges of *hidalgos* or noblemen.*

Along with these political privileges many of their social customs were equally unique. On the authority of Strabo, it was long asserted that the custom of the *couvade* existed among them—a practice common among primitive peoples, whereby on the birth of a child the father took to his bed as if in the pains of labor. This statement has never been substantiated in modern times; although the observance, found sporadically all over the earth, probably did at one time exist in parts of Europe. Diodorus Siculus asserted that it was practiced in Corsica at the beginning of the Christian era. There is no likelier spot for it to have survived in Europe than here in the

* For an account of these political rights, see W. T. Strong, The Fueros of Northern Spain, in Political Science Quarterly, New York, vol. viii, 1893, pp. 317–334.

Pyrenees; but it must be confessed that no direct proof of its existence can be found to-day, guide books to the contrary notwithstanding. The domestic institutions are remarkably primitive and well preserved.* Every man's house is indeed his castle. As Herbert puts it in his Review of the Political State of the Basque Provinces, speaking of Vizcaya: "No magistrate can violate that sanctuary; no execution can be put into it, nor can arms or horse be seized; he can not be arrested for debt or subjected to imprisonment without a previous summons to appear under the old oak of Guernica." The ties of blood are persistently upheld among all the Basques. The women enjoy equal rights before the law in many places. Customs vary from place to place, to be sure, and primitive characteristics are not always confined to the Basques alone. They are, however, well represented, on the whole. In some places the eldest daughter takes precedence over all the sons in inheritance, a possible relic of the matriarchal family which has disappeared elsewhere in Europe. It would be out of place to enlarge upon these social peculiarities in this place. It will be enough in passing to mention the once noted mystery plays, the folklore, the dances, the week consisting of but three days (as Webster asserts), and a host of other facts, each capable of inviting attention from the ethnological point of view. The only detail which it will repay us to elaborate is the language. To that we turn for a moment.

To the ordinary observer many peculiarities in the Basque language are at once apparent; *x*, *y*, and *z* seem to be unduly prominent—to play leading parts, in fact. There are more consonants alone, to say nothing of the vowels and double characters, than there are letters in our entire alphabet. For the linguist the differences from the European languages are of profound significance. The Basque conforms in its structure to but two other languages in all Europe, each of which is akin to the linguistic families of Asia and aboriginal America. It is formally like the Magyar or Hungarian; but this we know to be an immigrant from the East within historic times. It is also fashioned after the model of the speech of the Finns in Russia. These people are likewise quite foreign to western Europe; they are akin to tribes which connect them with the Asiatic hordes. The Basque alone of the trio is mysterious as to its origin; for it constitutes a linguistic island, surrounded completely by the normal population and languages of Europe.

In place of inflection, the Basque makes use largely of the so-

* E. Cordier. De l'Organisation de la Famille chez les Basques. Complete references in detail by authors will be found in a Bibliography of the Ethno-Geography of Europe shortly to be published in Bulletins of the Boston Public Library.

called principle of agglutination. The different meanings are expressed by the compounding of several words into one, a device not unknown, to be sure, in Aryan tongues; but in the Basque this is carried much further. The verb habitually includes all pronouns, adverbs, and other allied parts of speech. The noun comprehends the prepositions and adjectives in a like manner. As an example of the terrific complexity possible as a result, Bladé gives fifty forms in the third person singular of the present indicative of the regular verb *to give* alone. Another classical example of the effect of such agglutination occurs in the Basque word meaning "the lower field of the high hill of Azpicuelta," which runs

Azpilcuelagaraycosaroyarenberecolarrea.

This simple phrase is an even match for the Cherokee word instanced by Whitney:

"Winitawtigeginaliskawlungtanawneletisesti,"

meaning "they will by this time have come to the end of their (favorable) declaration to you and me." It justifies also the proverb among the French peasants that the devil studied the Basque language seven years and only learned two words. The problem is not rendered easier by the fact that very little Basque literature exists in the written form; that the pronunciation is peculiar; and that the language, being a spoken one, thereby varies from village to village. There are in the neighborhood of twenty-five distinct dialects in all. No wonder a certain traveler is said to have given up the study of it in despair, claiming that its words were all "written Solomon and pronounced Nebuchad nezzar."

Several features of this curious language psychologically denote a crudeness of intellectual power. The principle of abstraction or generalization is but slightly developed. The words have not become movable "type" or symbols, as the late Mr. Romanes expressed it. They are sounds for the expression of concrete ideas. Each word is intended for one specific object or concept. Thus there is said to be a lack of such simple generalized words as "tree" or "animal." There are complete vocabularies for each species of either, but none for the concept of tree or animal in the abstract. They can not express "sister" in general; it must be "sister of the man" or "sister of the woman." This is an unfailing characteristic of all undeveloped languages. It is paralleled by Spencer's instance of the Cherokee Indians, who have thirteen distinct words to signify the washing of as many different parts of the body, but none for the simple idea of "washing" by itself. The primitive mind finds it difficult to conceive of the act or attribute absolved from all connection with the material objects concerned. Perhaps this is why the verb in the

Basque has to include so many other parts of speech. The Arabic language is similarly primitive. It has words for yellow, red, green, and other tints, but no term exists to express the idea of "color," apart from the substance of the thing on which, so to speak, the color lies.

A second primitive psychological characteristic of the Basque is found in the order of the words. These follow the natural sequence of ideas more closely than in European languages. The importance of the idea determines precedence. Thus, instead of saying "of the man," the Basque puts it "man, the, of." Nouns are derived from one another in this manner. From *buru*, head, comes *buruk*, "head-for-the," or bonnet.* Many of the words thus contain traces of their derivation, which have long since vanished from the Aryan. Sayce gives some good examples. Thus *orzanz*, thunder, comes from *orz*, cloud, and *azanz*, noise. The word for month is *illabete*, derived from *illargi-bete*, meaning "moon-full." The first of these two parts is again divisible into *il*, death, and *argi*, light. In this manner we can trace the process of reasoning which induced the combination in many more cases than in our own languages. We still have some, like twilight or *hidalgo*, which in Spanish signifies "son-of-somebody," a nobleman; but these are the exception.

Probably the most primitive element in the Basque is the verb, or the relative lack of it. It was long asserted that no such part of speech existed in it at all. This, strictly speaking, is not true. Most of the verbs are, however, really nouns: "to give" is in fact treated as if it were "donation" or the "act of giving." It is then declined quite like a noun, or varied to suit the circumstances. This is indeed truly primitive. Romanes has devoted much time to proving that the verb requires the highest power of abstraction of all our parts of speech. Certain it is that it is defective in most primitive languages, from the Chinese up. Its crudity in the Basque is undeniable evidence of high antiquity.

The archaic features of these Basque dialects in the days when language and race were synonymous terms led to all sorts of queer theories as to their origin and antiquity. Flavius Josephus set a pace in identifying the people as descendants of Tubal-Cain and his nephew Tarsis. In the middle ages they were traced to nearly all the biblical heroes. Such hypotheses, when comparative philology developed as a science, gave way to a number of others, connecting the Basques with every outlandish language

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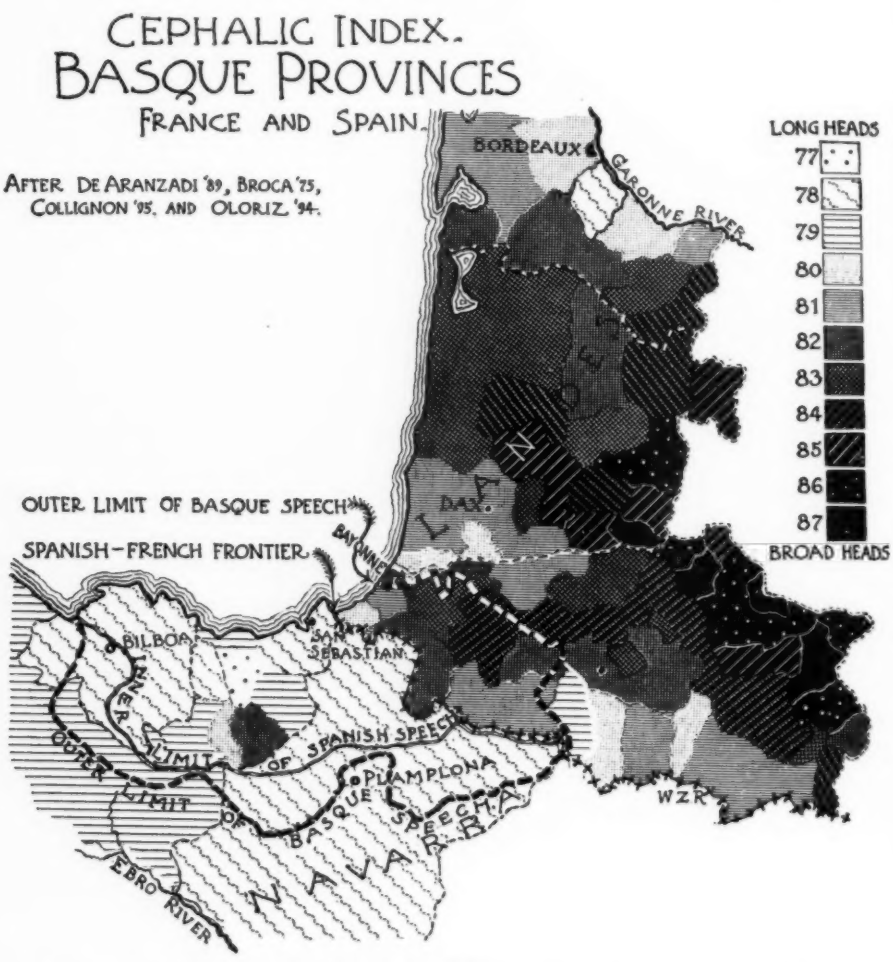
* Good details on the structure of Basque are given by Pruner Bey in Bulletins de la Société d'Anthropologie, 1867, pp. 39–71. Bladé, cited above, also describes fully. Jules Vinson is the best modern authority. *Vide* his Le verbe Basque in recent volumes of the Revue de Linguistique et de Philologie Comparée, Paris.

and bankrupt people under the sun. Vogt and De Charency connected them directly with the American Indians, because of the similarity in the structure of their language. Then De Charency changed his mind and derived them from Asiatic sources. Sir William Betharn made them kin to the extinct Etruscans. Bory de Saint-Vincent proved that they were the sole survivors of the sunken continent of Atlantis; of the type of the now extinct Guanches of the Canary islands. Max Müller gives some evidence of similarity to the Lapps, the Finns, and the Bulgarians. Others said the ancient Egyptians were related to them. We have no space to mention more. Little by little opinion crystallized, especially among the historians, about the thesis upheld by Wilhelm von Humboldt, that the Basque was a survival of the ancient Celt-Iberian language of Spain; and that these people were the last remnants of the ancient inhabitants of that peninsula. Pictet was the only linguistic dissident from this view, holding that the Basques were of even greater antiquity; being in fact the prehistoric race type of Europe, antedating the Aryan influx altogether. So much, then, for the conclusions of the philologists. Not very satisfactory, to be sure!

It will be observed that all these theories rested upon the assumption that racial derivation could be traced by means of language. A prime difficulty soon presented itself. Some thirty years ago the Basque language was found to be drifting toward the north, despite the apparent immobility of the people themselves. It seemed to be losing ground rapidly in Spain, with no indication of doing so, rather the reverse, in France. Nor was this apparently a new development. Everything denoted that it had been going on for many years. The mode of proof is interesting as Broca used it. There are two independent sources of evidence. In the first instance the place names all over Navarra as far south as the Ebro River are of Basque origin; although the language, as our map shows, does not to-day extend nearly as far. This indicates that the Basque speech prevailed when the villages, the mountains, and the rivers were named. No such zone of place names lies outside the speech line in France, save in one canton, just over the Pyrenees. There the Basque place names extend out as far as the broad white line upon our sketch, shown more clearly perhaps upon our other maps. The inward bend of the curve of present speech at this place points to a retrogression of language. Everywhere else in France the division line of place names coincides very closely with that of speech.

No less important proof that Basque is losing ground in Spain but holding its own in France is at hand. Notice on the map that the Spanish language is to-day in use considerably within the Basque limit. In other words, there is an intermediate zone in

Spain where both languages are understood and spoken by the peasants. This zone varies considerably in width. By the city of Plamplona there is a deep recess cut in the Basque. Castilian



being the official language, and Plamplona the capital of the province, the people in its vicinity have been compelled to adopt this language. They have forgotten their native Basque tongue entirely. At Bilbao, also an official city, the Spanish is actively forcing its way in; although the Basque language has more persistently held its own along this side. All along the frontier in Spain the Basque is on the retreat, much of the movement having taken place since the sixteenth century. In France, on the other hand, the Basque tongue holds its own. The line of demarcation between the Basque and the Bearnais-French *patois* is clean and clear cut. There is no evidence of an invasion of territory by the

outsider. This is equally true in respect to customs and folklore; so that the Basque frontier can be detected all along the line from village to village. The present boundary is of such a form that it denotes a complete equality of the two rival tongues. It has remained immovable for many generations.

The clearness of this frontier in France is interestingly illustrated by a bit of detail on the accompanying map. It concerns that loop which is roughly indicated upon the larger map just east of Bayonne. Here at the village of La Bastide-Clairence for generations has been a little tongue of Bearnais-French, penetrating deeply into Basque territory. The name of this town indicates a fortress, and another "Bastide" occurs in the tongue farther north. Broca inclines to the view that here was a bit of territory in which the French *patois* was so strongly intrenched that it held its own against the advancing Basque. It may have been a reconquest, to be sure. For us, the sharpness of frontier is the only point of concern, in contrast with the one in Spain. It is an undoubted instance of linguistic invasion toward the north.

Another difficulty, no less insuperable than the fact that their language was on the move in a quiescent population, lay in the way of the old assumptions that the Basques were pure and undefiled descendants of some very ancient people. Study of the head form precipitates us at once into it. No sooner did physical anthropologists take up the matter of Basque origins than they ran up against a pair of bars. Study of the cephalic index yielded highly discordant results. Those who, like Broca and Virchow, measured heads or skulls of the Basques in Spain, discovered a dolichocephalic type, with an index ranging about 79 on the living head. Equally positive were those like Pruner Bey, who investigated the head form on the French slopes of the Pyrenees, that the Basque was broad-headed. The indexes obtained in this

DETAIL—BASQUE-FRENCH BOUNDARY.

latter case clustered about 83. The difference of four units and over was too great to ascribe to chance variation or to defective measurement. The champions of the broad heads, such as Retzius and Pruner Bey, affirmed an Asiatic origin, while their opponents, following Broca, as vehemently claimed that, whatever the Basques might be, they certainly were not Mongolian. They generally asserted an African origin for them. The often acri-

FRENCH BASQUE. Basses-Pyrénées.

monious discussion has been settled finally by proof that both sets of observers were right after all. Strange as it may seem, the people on the two opposite slopes of the Pyrenees, both alike speaking the same peculiar language distinct from all others in Europe, were radically different in respect of this most fundamental racial characteristic. No proof of this, beyond a glance at our map of cephalic index, on page 620, is necessary. From preceding articles the broad heads in France, denoted by the dark tints, will be recognized as the extreme vanguard of the Alpine race of central Europe. Spain, on the other hand, is a stronghold of the long-headed Mediterranean type. Here we have the point of contact between the two. Let us not be confused by the light-shaded area about Dax. That is not truly Mediterranean. It need not bother us. Dr. Collignon identifies it as a remnant of the same prehistoric Cro-Magnon race, centering in Dordogne, which we described in our last paper.

Bearing in mind now that the crest of the Pyrenees runs along the political frontier, it seems as if, on the whole, the line of division between broad-headed and long-headed types lay at the northern base rather than along the summits of the mountains.

This is indeed true. Apparent exceptions prove the rule; for where, in the heart of the Basque territory, the broad heads seem to penetrate to the Spanish frontier, there is the ancient pass of Roncesvaux, celebrated in history and literature. The broad-headed type would naturally have invaded here if at all. Everywhere else the long-headed type seems to prevail, not only on the Spanish slopes, but clear over to the foothills of the Pyrenees on the other side in France.*

If these facts be all true, what has become of our Basque physical type? Where are our philological theories of purity of racial representation? If the Basques are indeed an unmixed race, there must be one of these two types which is false. At first the anthropologists sought thus to reject one or the other, French or Spanish, for this reason. Then they laid aside their differences; they abandoned entirely the old theory of purity of descent. The Basque became for them the final complex product of a long series of ethnic crosses. Each of the conflicting characteristics was traced to some people, wherever found it mattered not. The type was compounded by a formula, as a druggist puts up a prescription. Bladé wrote in the light of such views. Canon Taylor,

SPANISH BASQUES. Tolosa, Guipuzcoa.

in his Origin of the Aryans, holds that the broad-headed French Basque is only a variation of the Alpine type which we have seen prevails in all the southwest of France, with a dash of Lapp blood. For him the Spanish Basque was, on the other hand, a subtype of the long-faced Iberian or Spanish narrow head. The

* The general limits of the mountainous country are shown by the five-hundred-meter contour line on our subsequent map on page 625.

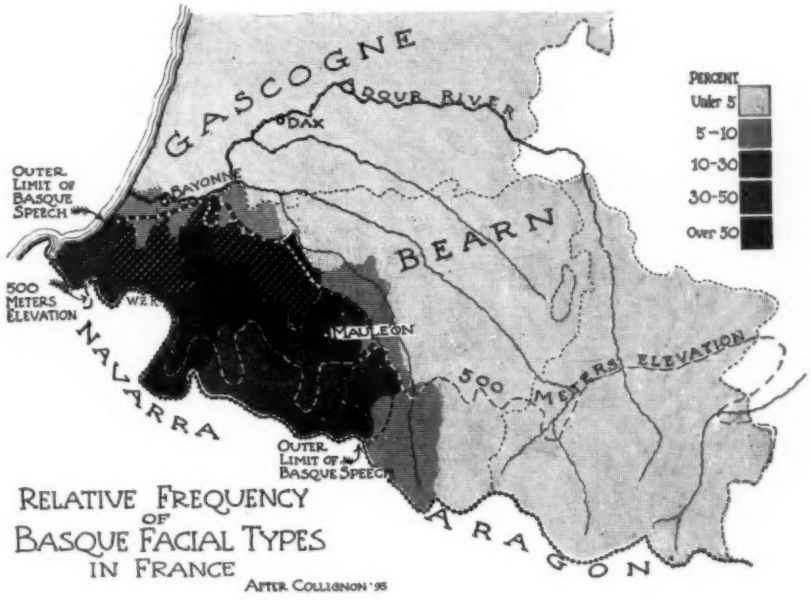
result of the crossing of the two was to produce a peculiarity of physical feature which we shall shortly describe—namely, a broad head and a long, narrow face. Aranzadi, himself a Basque, assigns an equally mixed origin to his people. His view is that the Basque is Iberian at bottom, crossed with the Finn or Lapp, and finally touched by the Teuton.

Is there, after all, a Basque physical type corresponding to the Basque language? Enough has already been said to cast a shadow of doubt upon the assumption. Can it be that all which has been written about the Basque *race* is unwarranted by the facts? Let us examine a few portraits collected from both slopes of the Pyrenees. They appear on page 622 and the following pages. At once a peculiar characteristic is apparent in nearly every case. The face is very wide at the temples, so full as to appear almost swollen in this region. At the same time the chin is very long, pointed, and narrow, and the nose is high, long, and thin. The outline of the visage becomes almost triangular for this reason. This, with the eyes placed somewhat close together, or at least appearing so from the breadth of the temples, gives a countenance of peculiar cast. It resembles, perhaps, more than anything else the features of so-called infant prodigies, in which the frontal lobes of the brain have become overdeveloped. The contrast appears especially strong when we compare this Basque type of face with that of its neighbors. The people all about have very well-developed chins and regular oval features, in many cases becoming almost squarish, so heavily built is the lower jaw. A Basque may generally be detected instantly by this feature alone. The head is poised in a noticeable way, inclining forward, as if to balance the lack of chin by the weight of forehead. The carriage is always erect, a little stiff perhaps. This may be because burdens are habitually carried upon the head. On the whole, the aspect is a pleasant one, despite its peculiarities, the glance being direct and straightforward, the whole bearing agreeable yet resolute.

The peculiar triangular facial type we have described—characteristic both of Spanish long-headed or French brachycephalic Basques—has been mapped by Dr. Collignon for the north slope of the Pyrenees with great care. We have reproduced his map on this page. It is very suggestive. It shows a distinct center of distribution of the facial Basque wherein over half the population are characterized by it. Concentric circles of diminishing frequency lie about it, vanishing finally in the plains of Béarn and Gascogne. The most noticeable feature is the close correspondence of this distribution of a physical type with the linguistic boundary. It is exact, save in one canton, Aramitz, at the eastern end southeast of Mauléon. Here it will be remembered was

the one spot in France where there was evidence in the place names of a retrogression of the Basque speech before the French. The light-dotted line shows the former boundary. It is the one French-speaking canton, with nearly a quarter of the population of the Basque facial type. The exception proves the rule. Some relation between language and racial type is proved beyond a doubt.

Another significant fact is illustrated by this map. It appears that instead of being refugees isolated in the recesses of the Pyrenees, the Basque physical type is really most frequent in the foothills and open plains along the base of the mountains.

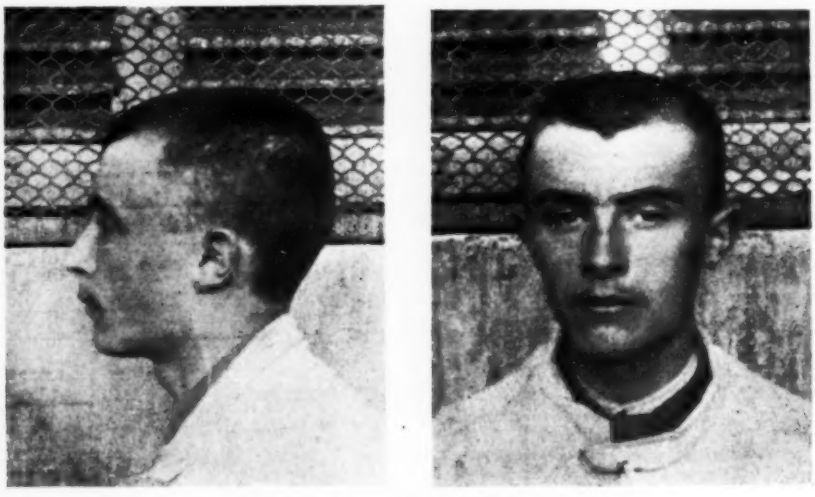


In order to emphasize this point we have indicated the lay of the land upon our map by means of the five-hundred-meter contour line of elevation above the sea. It shows that in the Basque country the mountains are much narrower than farther to the east. The Pyrenees, in fact, dwindle away in height down to the seacoast. The only canton in the mountains proper with upward of half the population of the Basque facial type lies at the famous pass of Roncevaux. At this point the contour line sweeps far south, well toward the frontier. Of the three cantons with the maximum frequency of triangular faces among conscripts, Dr. Collignon found two and a half to be outside the mountains proper. The area of their extension is shaped like a fan, spreading out toward the plain of Béarn. The two wings of the fan are the cantons which form the core of the ethnic group. This re-

gion, Basse-Navarre, has always enjoyed a considerable political autonomy. Quite probably the ethnic segregation is due in part to this cause, as well as to the peculiarities of language. This fact that the Basques are not an ethnic remnant barely holding their own in the fastnesses of the Pyrenees, as is generally affirmed; but that they have politically and ethnically asserted themselves in the open fertile country, reverses their status entirely. It confirms an impression afforded by a study of their language that however it may be in Spain, these people are a positive factor in the population of France.

BROAD-HEADED TYPE. Like the Bearnais.

In reality we have here in the department of Basses-Pyrénées a complex ethnological phenomenon, the Basques constituting the middle one of three distinct strata of population lying on the north slope of the Pyrenees. Our map of cephalic index, on page 620, serves to illustrate this. The plains of Béarn are occupied by the extreme western outpost of the broad-headed, round-

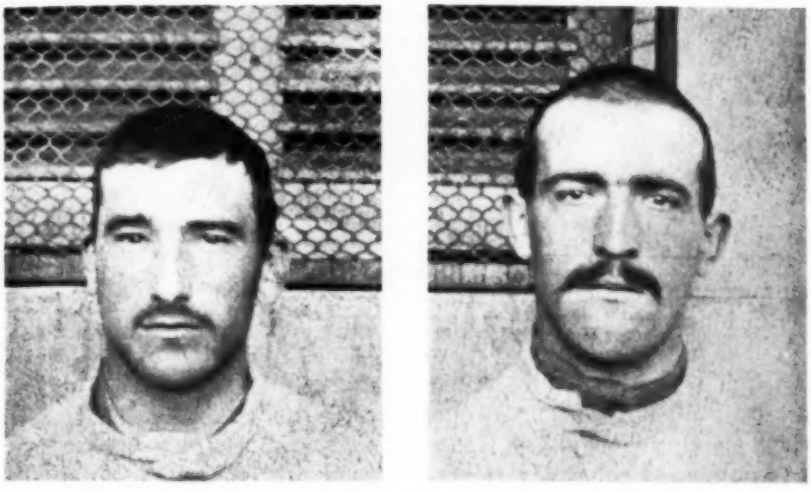


FRENCH BASQUE. Basses-Pyrénées.

faced Alpine type of central Europe. A portrait of one of these is given on this page. Then come the Basques proper, with their broad heads and triangular faces. These lie mainly along the

foothills, although at Roncevaux extending back into the mountains proper. Behind them, in the recesses of the Pyrenees, is the third layer of population. These mountaineers are distinctly dolichocephalic. Conscripts with the characteristically narrow head, the long and smoothly oval face, are depicted in portraits on this same page. These last people are really Mediterranean in type, overflows from the true Iberian stock, which forms the bulk of the Spanish population. This ethnic segregation has probably been preserved because of the political independence of the people of the mountains during many generations. These three groups merge into one imperceptibly to the eye; but on analysis their differentiation from one another has now been clearly established.

How has it come to pass that our Basques are thus left interposed between two neighboring populations so entirely distinct



MEDITERRANEAN DOLICHOCEPHALIC TYPES. Pyrenees Mountains.

in respect of these important racial traits? Is it permissible to suppose that the intermediate zone in which the triangular face occurs most commonly is really peopled by a simple cross between the two ethnic types on either side? This would be similar to Canon Taylor's supposition that a brachycephalic parent stock determined the head form of the Basques, while the narrow lower face and chin was a heritage from a dolichocephalic long-visaged ancestry. Such disharmonic crania arise sometimes from crossing of the two types of head form, especially in Switzerland, where the Teutonic and Alpine races come into contact with one another. An objection to this theory of secondary origin by intermixture is close at hand. It is fatal to the assumption. It is an important fact that the Basques are relatively

broader-headed than even the neighboring peasantry of Béarn, and of course even more so than the long-headed Spanish population across the Pyrenees. Turning back to our map on page 620, this will appear. Of course, the Basques are not more extreme in this respect than the pure Alpine type; we mean that they rise in cephalic index above their immediate and adulterated Alpine neighbors in Béarn. This implies, of course, that they are at the same time far broader-headed than the Spanish Basques over the mountains. Thus we dispose at once of the explanation offered both by Canon Taylor and De Quatrefages for the broad-headedness of the French over the Spanish Basque. Taylor accounted for this marked difference between the people of the two opposite slopes of the Pyrenees on the supposition that in invading Béarn from Spain the Basques intermarried with the broad-headed Alpine stock there prevailing, and so deviated from their parent type. This fact that we have mentioned, that in France in their greatest purity the Basques are broader-headed than the Béarnais about them, proves beyond question that they are brachycephalic by birth and not by intermixture with their French neighbors. In Spain, on the other hand, the facial Basque, if we may use the term, is slightly broader-headed than his purely Spanish neighbor. Surrounded thus on all sides by people with longer and narrower heads, we are forced to the conclusion that this people is by nature of a broad-headed race. An important corollary is that the pure Basque is to-day found in France and not in Spain, although they both speak the same language. This exactly reverses Taylor's theory. It is the Spanish Basque which is a cross-type—in other words, narrower-headed by four units than the French Basque because of intermixture with the dolichocephalic Spaniards. Those who are found here in Spain are probably stragglers; they have merged their physical identity in that of their Spanish neighbors. Their political autonomy on this south side of the mountains being less marked, the power of ethnic resistance vanished quickly as well.

Having disposed of the explanation of origin by intermixture, the only hypothesis tenable is that these Basques are immigrants —that they are an intrusive people. Dr. Collignon's explanation is so simple and agrees so well both with history and with anthropological facts that we give it as nearly as possible in his own words: During the Roman imperial rule a number of petty Iberian tribes, by virtue of the same tenacity which enables their descendants to enjoy political autonomy to this day, had preserved a similar independence south of the Pyrenees. Such were the Vardules, Caristes, Autrigons, and the Vascons (Basque—by no means physically identical with the Gascons, although derived from the same root word). These last occupied the upper

course of the Ebro—that is to say, modern Navarra in Spain. The barbarian invasions ravished all Gaul with fire and sword. The Visigoths, controlling for a time the two slopes of the Pyrenees, were finally expelled from Aquitaine by the Franks, greater barbarians even than they. It is readily conceivable that these Visigoths about this time began to covet the rich territory of the Vascons over in Spain, especially the environs of Plamplona, which were of great strategic importance. History furnishes no details of the conflict, except that the Vascons were completely subjugated and partly driven into the Pyrenees. Here they speedily found their way over into Béarn in France, meeting no opposition since the country there had mainly been depopulated by constant wars. This occupation by the Vascons, according to Gregory of Tours, took place in the year 587—that is to say, some time after the fall of the Roman Empire. The invasion was accelerated later through the pressure exerted by the Spaniards, fleeing before the Saracen conquerors in the south. Remnants of all the Spanish peoples took refuge at this time in the north. Impelled by this pressure from behind, the Vascons were driven out of the Pyrenees and still farther north into France, retaining their political autonomy under Frankish rule. Here they remained undisturbed by the Saracens, save by the single army of Abd-er-Rhaman. Hence on this northern side of the Pyrenees they have preserved their customs and physical characteristics intact, while in Spain intermixture has disturbed the racial type to a greater degree. The language alone has been better preserved south of the mountains because it was firmly fixed there before the Spanish refugees came in such numbers. Of our three layers of present population the dolichocephalic type in the fastnesses of the Pyrenees to-day represents the primitive possessors of Aquitaine. Here, driven to cover by the advancing wave of the Alpine stock on the north long before the fall of Rome, they have remained protected from disturbance by the later invaders from the south. The Vascons or Basques have simply passed through their territory, with eyes fixed upon the fertile plains of Aquitaine beyond. They spread out in two wings as soon as they were out of the mountains, as we have seen. In the course of time they have intermarried with

SPANISH BASQUE.
Zamudio, Guipuzcoa.

the primitive population of the Pyrenees; and the latter have adopted the Basque language and customs: for they were penned in by them all along the base of the mountains and had no other option. This community of language and customs could not fail to encourage intermarriage; to the final end that to-day in the mountains the Basque is considerably crossed, as our map shows. In the plains, on the other hand, the line of demarcation of blood is as sharp as that of speech. Purity of type on this side was made possible by the political independence which Basse-Navarre has always enjoyed.

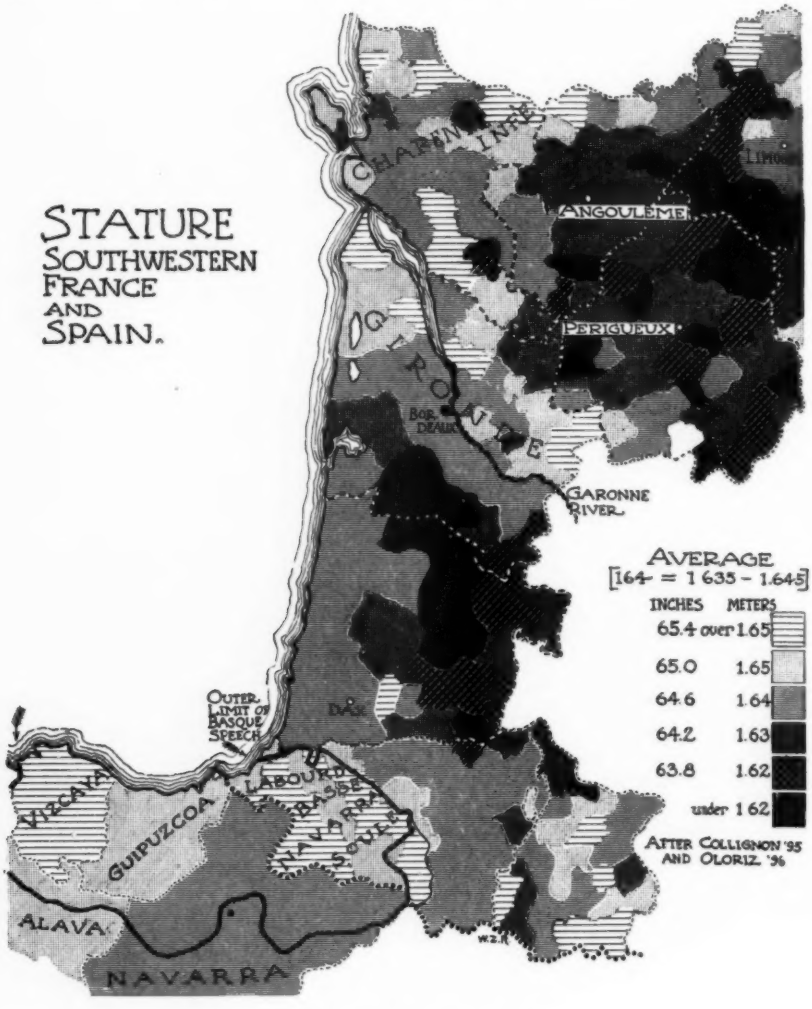
We have still to inquire as to the physical origin of this curious people. We have traced them back to Spain. Whence did they come into this country in the first place? Are they of African descent, following Broca's theory, or are they offshoots from Mongolian stock as Pruner Bey would have it? Or must we class them with the lost tribes of Israel? We already know the physical type of the prehistoric Cro-Magnon race. Let us compare it with our Vascons and test the theory of descent from it. The Basque head is disharmonic—that is, it is broad, while the face is extraordinarily narrow. This is in contravention of the general law that the face and the head usually participate alike in the relative proportions of breadth and length. Thus, as our portraits have shown, the broad-headed Alpine stock in Béarn has a round, short face; while the dolichocephalic population of the Pyrenees, lying behind the Basque, has a correspondingly long, oval visage. The Cro-Magnon race offers the only other example of a widespread disharmonic head in Europe. Are our Basques derived from this pure ethnic source? Curiously enough, these two cases of disharmonism so near to one another cross at right angles. In the Basque the head is broad and the face narrow; in the Cro-Magnon it is the head which is narrow while the face is broad. In view of this flat contradiction, the hypothesis of the Basque as a direct and pure descendant of the most primitive prehistoric population of Europe becomes completely untenable. Thus we dispose of one possible source for this people. We have already rejected those based upon intermixture. The broad head of our Basque with its narrow face is explained by De Aranzadi, himself a Basque, by the supposition of an admixture of Lapp blood to give the broad head with Iberian or Berber blood for the narrow face. Modern research is, however, inimical to such hasty assumptions of migrations across continents and over seas: for the inertia of simple societies is immense. Causes of variation nearer at home are regarded as more probable and potent, and there is none more powerful than social selection.

The difficulty of placing the Basque is solved by Dr. Collignon in a novel and yet simple way which has won favor already

among anthropologists. It is of great significance for the student of sociology. His explanation for the Basque type is that it is a subspecies of the Mediterranean stock evolved by long-continued and complete isolation, and in-and-in breeding primarily engendered by peculiarity of language. The effects of heredity, aided perhaps by artificial selection, have generated local peculiarities and have developed them to an extreme. The objection to this derivation of the Basque from the Mediterranean stock which at once arises is that the latter is essentially dolichocephalic, while the Basques, as we have shown, are relatively broad-headed. It appears, however, that the Basque is broad-headed only at one spot, and that far forward near the temples. The cranium itself at its middle point is of only medium width and the length is only normal. The proportions, in fact, excluding the frontal region, are very much like those of the Mediterranean stock in Spain across the Pyrenees. They approach much nearer to them, in fact, than to the Alpine or broad-headed stock. It is thus only by its abnormal width at the temples that the cranium of the Basques may be classed as broad-headed. Dr. Collignon regards the type, therefore, as more or less a variation of the Mediterranean variety, accentuated in the isolation which this tribe has always enjoyed. It approaches in stature and in general proportions much nearer also to the Mediterranean than to the Alpine stock in France.

That the Basque facial type—that which is recognized as the essential characteristic of the people, both in France and Spain—is a result of artificial selection, is rendered probable by another bit of evidence. The Basques, especially in France where the type is least disturbed by ethnic intermixture as we have seen, are distinguishable from their Béarnais neighbors by reason of their relatively greater bodily height. This appears upon our map of stature on page 632. The lighter tints denoting taller statures are quite closely confined within the linguistic boundary. This is not due to any favorable influence of environment; for the Basque foothills are rather below the average in fertility. The case is not analogous to that of the tall populations of Gironde, farther to the north, light tinted upon the map. They, as we took occasion to point out in the preceding paper, are above the average either in Dordogne on the north or in Landes on the south. The contrasted tints show this clearly. These differences are in great measure due to the surpassing fertility of the valley of the Garonne, as compared with the sterile country upon either flank. No such material explanation is applicable to the Basque stature. Some other cause must be adduced. Ought not artificial selection, if indeed it once became operative in a given ethnic group, to work in this direction? Goodly stature is earth-

wide regarded as a type of beauty. We know that the Basques are proud of this trait. May they not have evolved it, or at least perpetuated it, by sexual choice perhaps? This, of course, is



merely supposition on our part, but it seems to be worthy of mention.*

The development of a facial type peculiar to certain localities is by no means a rare phenomenon. We shall have occasion to

* The apparently contradictory low stature in Spanish Navarra need not disturb us. No attempt was made by Oloriz to differentiate the Basque half of the province from the other. Hence the figures obtained are truly characteristic of neither. The data are defective for all Spain, as compared with the detailed researches of Collignon upon the French side.

call attention to it later in other portions of Europe, particularly where isolation prevails. The form of the nose, the proportions of the face, nay at times the expression, seem to be localized and strongly characteristic. It is easy to conceive of an artificial selection in an isolated society whereby choice should be exercised in accordance with certain standards of beauty which had become generally accepted in that locality. It is merely an illustration of what Giddings, in his Principles of Sociology, aptly terms a recognition of "consciousness of kind"; or as Dr. Beddoe puts it, of "fashion operating through conjugal selection." An example of the effect of selection of this kind in producing strongly individual types is offered by the Jews. They as a race vary greatly in the proportions of the head; and in color of eyes and hair to a lesser degree. Nevertheless, despite all variations in these characteristics the prominent facial features remain always the same. The first, being inconspicuous traits, are allowed to run their natural course; the latter are seized upon and accentuated through the operation of sexual preference for that which has become generally recognized either as beautiful or ethnically individual.

In the attempt to justify this interesting sociological explanation for the peculiarities of the Basques, causing them to differ

FRENCH BASQUE. Basses-Pyrénées.

from their parent Mediterranean stock, several corroborative facts have come to light. Certain customs among the peasants seem to imply a recognition of their facial individuality. These all tend to accentuate the peculiarities which have now apparently become hereditary among them. The chin is almost invariably

shaven in the adults, with the effect of exaggerating its long and pointed formation. More conclusive still, it is said that in early manhood side whiskers are often grown upon the broadest part of the cheeks. This would obviously serve still more to exaggerate the peculiar form which the face naturally possesses. A neighboring people, the Andalusians, differ in their way of adorning the face in such wise as to heighten the contrast between themselves and the Basques. Among them chin whiskers are grown, which serve to broaden their already rounded chins and to distinguish them markedly from the pointed-chinned Basques. All this fits in perfectly with much of the evidence brought forward by Westermarck, in his History of Human Marriage, serving to show that the fashions in adornment which prevail among various peoples are largely determined by the physical characteristics which they naturally possess. Thus the North American aborigines, having a skin somewhat tinged with a reddish hue, ornament themselves almost entirely with red pigment, heightening still more their natural characteristics. Among the negroes a similar fact has been observed, in each case the attempt being to outdo Nature.

Is it not permissible to suppose that here the same process has been at work gradually remolding the physical type? A far-reaching and bold hypothesis this, to be sure. It would have less probability in its favor did we not observe in modern society many phenomena of fashion and custom closely akin to it in their immediate effects. We have but to suppose a fashion arising by chance, or perhaps suggested by some casual variation in a local hero or prominent family. This fashion we may conceive to crystallize into customary observance, until finally through generations it becomes veritably bred in the bone and part of the flesh of an entire community. A primary requisite is isolation—material, social, political, linguistic, and at last ethnic. No other population in Europe ever enjoyed all of these more than the Basques. If such a phenomenon could ever come to pass, no more favorable place to seek its realization could be found than here in this uttermost part of Europe.

DEFENDING the use of scientific terminology in scientific books, a reviewer in The Athenæum maintains that "those most interested soon become familiar with the meaning of terms, and, experiencing their convenience, adopt them. It is only those who have no real knowledge or interest in the subject who refuse to read a book because they have not mastered the alphabet. We do not think it possible that anybody who would take the trouble to master the structure of half a dozen plant types could remain in ignorance of a considerable amount of terminology, or could express himself rationally without it if he tried."

OBJECTS AND RESULTS OF POLAR RESEARCH.

By GEORG GERLAND

LEAVING out of view the commercial enterprises of the ancient inhabitants of the Iberian Peninsula and the voyages of the primitive Celtic people of Britain, the earliest explorer of the north was a younger contemporary of Alexander the Great, Pytheas of Marsilia, who braved the perils of that region, impelled by purely scientific motives. He returned with abundant results, but was not understood by the people of his time, and more than two thousand years elapsed before men sailed north again in scientific inquiry. It is true that many voyages were made to the north during the middle ages. The Northmen during that period founded colonies in Greenland, in the farthest north, as their countrymen settled in the fair southern regions of Apulia and Sicily; but both sets of settlements failed to be of permanent establishment. The voyage of the Venetian Zeno to the Farö Islands in 1390 was without historical significance, and the voyage of Christopher Columbus beyond Iceland in 1477 is mythical.

At the close of the middle ages, when the deficiency of knowledge of the earth was great, avarice and the quest for the goods of the south led men into the northern ice; they sought to reach India by the shortest possible routes, where they would not meet rivals and enemies. This was the object of Magellan's circumnavigation. The *Ceterum Censeo* of James Lancaster asserted that the way to India was north, around America. India was the object of the polar navigators Cabot in the fifteenth, Frobisher and Davis in the sixteenth, and Hudson and Baffin in the seventeenth centuries, to name only a few of the most famous. It is astonishing what these daring British and Dutch sailors risked, suffered, and gained.

They did not, indeed, reach India, but we all know of Hudson Bay, Davis Strait, and Lancaster Sound. As we owe to the men of the stone age, who lived before all history, one of the most important possessions of man, the great paths they marked out upon the earth across streams, over mountains, and through wilderness and plain, which are still the routes of to-day's highways, so these older arctic navigators mapped out the courses of their successors. The ships of the whalers and seal hunters followed them, discovering one bay, island, and channel after another, naming them and marking them on maps.

In the seventeenth century appeared such men as Kepler, Cassini, Newton, and Boyle. The shape of the earth was actively discussed, improved maps were made, and new aims and motives

were conceived, the development of which has caused the nineteenth century to be so sharply distinguished from its predecessors. Now knowledge of the earth is sought for itself, and in this respect the polar research of the present has all at once assumed another aspect, under which it is differentiated from that of the past. Northwestern and northeastern passages have been sought in our days, but not in order to reach India. When Maclure achieved the former in 1852 and Nordenskjöld the latter in 1879, the value attached to the discoveries was not that they furnished routes, but that a correct knowledge of the northern coasts of the two continents and rich stores of other scientific information had been gained by them. Fruits like those, no longer the interests of trade, justified the high prizes which the English Government offered for the discovery of the passage, and the costly expeditions which were dispatched for that purpose. The early trade routes became highways for scientific investigation, and the nature of the polar regions as a whole was inquired into. Such objects were pursued by individuals. Scoresby, while hunting for whales, made constant studies of the highest scientific value of the hydrography, magnetism, and meteorology of the arctic regions; and so did Karl Ludwig Gieseke, afterward Professor of Mineralogy at Dublin, who traveled through East and West Greenland from 1807 to 1813 solely for the thorough study of the geology of their coasts.

Till 1860 the English, and afterward the Americans with them, were in the front as polar explorers. The most important results of their work were the discovery of the magnetic pole in 1831 by John and James Ross, the definition of the coast of arctic America, and numerous single observations. More recently other nations have come forward—the Danes in Greenland, and the Swedes, whose most illustrious representative is Nordenskjöld. Two German expeditions have been sent to East Greenland, an Austrian expedition under Weyprecht and Preyer has discovered Franz-Joseph Land, the Dutch have explored south of Spitzbergen, the Russians on the northern coast of Siberia, and now with Nansen and Mohn the Norwegians have advanced to the very front. In 1882–'83, at the instance of the German Neumayer and the Austrian Weyprecht, a chain of observation stations was established around the pole, to be kept up for a year—an enterprise in which Germany, England, the United States, Russia, Austria, France, Sweden, Norway, and Finland took part. The year 1883 was further marked by Nordensjöld's return from the inland ice of Greenland, and by Nansen's conception of his scheme for traversing Greenland on snowshoes, which he carried into effect the next year. North polar research is therefore almost exclusively the work of the Germanic nations, for the Russian ex-

plorers have been chiefly of that stock. The Romanic nations, no less seafaring people, have kept away from the north pole; but France has done something in south polar exploration.

The south pole has been comparatively neglected on account of the unfavorable character of its surroundings. Large masses of land are wanting, and the immense wastes of water of the South offer only a few islands possessing neither large mammals nor human inhabitants; while the Eskimos of the North are of incalculable advantage to exploration. Magellan's southern voyage was not followed up for two hundred and fifty years. The first after him to reach high southern latitudes was James Cook, in 1774, and no other similar expeditions followed for fifty years more. Those best known were those of the French under Dumont d'Urville in 1839, of the Americans under Wilkes, and of the English under James Ross, who in 1842 penetrated to the seventy-eighth degree, the highest southern latitude yet attained. After a year's maintenance of a German station on the South Georgian Islands and of a French station at the southern point of America, both of which belonged to the international system of 1883, and after a few dashes southward in later years, a number of nations —Germany, Austria, England, the United States, and others—are again preparing to co-operate in another polar siege at the austral end of the world for the benefit of science.

The question rises, What is the good of all this effort, this toil, this risk incurred in seeking inaccessible regions? The prospect of adventure, of witnessing strange scenes and experiencing unwonted conditions, of displaying prowess and achieving victory over formidable obstacles, may account in part for the readiness with which individuals are tempted to go into arctic expeditions, but not so with governments. And governments can not expect any practical material gain from such enterprises sufficient to justify the expenditures which they willingly lavish upon them.

Yet there is a real gain in a higher sense to be derived from them. They contribute to the enlargement of our knowledge, to the widening of our circle of view, to the increase of our mental capacity and ability; they make us better acquainted with the planet on which we live, and help us achieve a mastery over it.

Nowhere are more questions to be found for which to seek answers than in the polar regions. Here the magneto-electric light of the earth manifests itself in the wonderful phenomenon of the northern lights. All the wind currents of the earth press toward the pole, and the sea currents too. Curious dispositions of Nature are found here, with great volcanoes, the outer cones of which are constituted of strata of ice covered with lava, and

under the masses of ice we discover remains of plants that demonstrate the presence not so very long ago of a flourishing tropical or subtropical vegetation instead of the present ice. We meet mountains of ice everywhere, and everywhere the arctic region is sublime. Man's disposition to make all the earth his home and himself at home everywhere in it is only sharpened by the problems offered there, and the tendency to go becomes irresistible.

There is thus much to observe and much to learn in these regions for the satisfaction of our irresistible longings. First, we are able to study in the polar regions the division of land and sea, the size, elevation, and topography of the land—the whole question, in short, of polar geography. The form of the earth's surface is not casual, but is the result of interactions of the crust and the interior of the globe. The discovery by Nansen's expedition of the profundity of the polar sea tallies with Prof. Mohn's observations of the great depths between Greenland and Spitzbergen and with those of the fiords and interinsular channels of the North Atlantic. Further, the sea bottoms are penetrated by volcanoes, some of them still active—here single, as in Jan Mayen Island, there in groups, as in Franz-Joseph Land and Fire Island. A marked difference exists in this respect between the Atlantic half of the polar regions north of Europe and eastern North America, where disturbance and divisions of the land are the rule, and the Pacific side, north of Siberia and western America, where quiet prevails, with regular coast forms and few islands. The lands on the Atlantic side have, moreover, been gradually rising for an incalculable length of time, and are still rising, while those on the opposite side have until very recently been subsiding. These facts, selected as examples from a great number of phenomena, may serve to illustrate how important is a knowledge of the polar regions to that of the earth as a whole. Its importance is, in fact, quite beyond comprehension.

So the magnetism of the earth, the colored beams of the northern lights, the flickering of their draperies and bands, are of interest far beyond their relations to the earth alone; for the movement of the magnetic elements reflects the processes of the sun's atmosphere, and may be connected with the immense periods of the revolution of our solar system. Man could not refrain from inquiring into the nature and reason of these things even if he would, and hence he is willingly or unwillingly led to the poles, where he is brought into the closest relations with them, and where the explanation of them can be most hopefully sought.

A relation between the northern lights and the weather has been established by repeated observations, and that brings us to

another group of phenomena, those of meteorology, which are of interest to the whole earth, and are especially remarkable in the polar regions. An interchange of great wind currents between the equator and the poles is constantly going on, upon which the movements of the atmosphere and the pressure in the intermediate regions are ultimately dependent, and the study of the atmospheric phenomena of the polar regions is indispensable to our proper knowledge of them.

The excess of heat at the equator forces masses of air into the highest regions of the atmosphere; the congestion at the pole, the necessary consequence of accumulation there, forces them back to the earth. On their way through the higher regions these masses are attenuated and cooled, so that, even when condensed at their sinking, they can not overcome the polar cold; and as they bring little moisture, and consequently little cloudiness, the radiation of heat goes on continuously during the long polar night; the more so because snow and ice are extremely good radiators. Hence the extreme cold which Nansen found in Greenland, and which makes that interior a second pole of cold along with that in the interior of Siberia, is fully explained.

Yet the winds contribute to the warming of the polar sea. They drive the waters from warmer regions in wide superficial currents into the higher latitudes, where, being heavier in consequence of their greater content of salt than the fresher water resulting from the melting of the glaciers and the ice and from the outpour of the great Siberian rivers, they sink beneath them to the bottom and keep the temperature of the sea constantly above the freezing point. The colder, lighter water has to give way to these under-sea currents, and flows into the Atlantic Ocean, cooling the American coasts. At the south pole currents flow in from all the seas, and superficial waters spread into all the oceans.

How shall we account for the masses of polar ice, for the immense icebergs, and the glaciation of Greenland? The snowfall of the polar regions is light. The air is nowhere drier than over the cold glacier ice, as is proved every day in Switzterland by the quickness with which clothes dry when hung over it. At the same time the ice is covered with extremely fine, hardly visible snow crystals. If we boil water in a retort which is connected with another vessel containing a piece of ice, all the steam will pass over on to the ice and deposit itself as ice upon it. The same takes place in a larger degree on the earth, where the retort is the warm evaporating water of the tropical regions, the connecting pipe is the upper atmosphere, and the thickening ice is at the pole. Thus, without any rain or snow falling, all the moisture and all the vapor is withdrawn from the atmosphere by this ice

and deposited upon it in fine crystals; and as the influx of air is constant and all-pervading, a never-ceasing supply of frost is going on all the time. In consequence of the larger quantity of moisture, the process is still more marked and regular at the south pole. The explanation of the glaciation of the northern part of our temperate zone during the ice age, still unfound, is a matter of great importance, for the present topography of the land was brought out and the organic life of the whole earth was modified by it; and it is the general opinion that the solution of the problem is to be found, if it is found, by the study of the polar regions.

In the period immediately preceding the ice age the polar regions were not covered with ice, but had a rich growth of plants, reaching up even to the glaciers of their mountains, and plants were represented in them which are now known only in warmer countries. This was a very noteworthy time in the history of the earth. Organic life, in the continents at least, was in its greatest extension, and, I believe, specificism and diversity. The forests also were more luxuriant than now. And this was the time when man originated. Upon this came the ice age, during which man was scattered over the whole world, and organic beings were divided according to their capacity to resist the cold into the three great classes of arctic, temperate, and tropical life—a division which probably existed too during the earlier period, but then only locally, as on mountain ranges. The study of the organic life of the poles is therefore of the greatest importance for the understanding of the history of the organic life of our planet; and the more so because the arctic region has always been an important station for the distribution of organisms. The plants and animals of the south polar lands, on the contrary, and of the pointed southern continental terminations have never shown any permanent community with one another. This peculiar feature of the southern continents appeared very early.

Knowledge concerning the origin and spread of peoples may likewise receive valuable contributions from polar research. That is shown by the Eskimos and their wonderful adaptation to that nature which is so destructive to civilized peoples. In this we have a clear demonstration of the maxim which is one of the most important if not the most important law of all organic and human life: that what is to be permanent can be brought about only by gradual, extremely slow formation; never by sudden, immediate transition, or by sharp, violent breach. It is the same in the mental life. It is impossible to create anything new and enduring by simply casting the old away. Only what has connection has permanence. This maxim may be called the funda-

mental law of all development; and as it certainly prevails for earthly life, so it does for the existence of human society. This principle is illustrated, and is destined to be more extensively so, from observations in the polar regions.—*Translated for the Popular Science Monthly from the Deutsche Rundschau.*

THE GIANT CACTUS.

By Prof. JAMES W. TOUMEY.

PEOPLE in general are but little impressed by the many forms of life, be they plant or animal, with which they daily come in contact. A tree of unusual size, or a flower of exceptional form or color, attracts our attention. It is the unusual in Nature which always catches the eye. The New England boy grows to manhood under the widespreading boughs of the American elm, in sight of grass-covered mountains and winding rivers. The natural beauty of his surroundings is a part of himself. So, also, the Papago Indian sees nothing peculiar in the many forms of life characteristic of the region where he makes his home.

He can not listen to the whispering of the leaves, because the trees of his limited world do not grow them. He knows nothing of tangled woods, but draws his inspiration from the broad, hot, cactus-covered plains and the granite-walled and lava-strewn mountains.

The many and varied species of cacti, which constitute the vegetation most familiar to him, are the most peculiar of all forms of vegetable life to those who live beyond the limits of our arid region. Of all these strange plants the *sahuaro,* or giant cactus, on account of its great size and striking aspect, is the most impressive. We can well imagine the feeling of the early explorers when they first came in sight of these towering plants, so abundant on the foothills contiguous to Salt River Valley, and from where they extend southward far into Mexico. The finest and largest specimens that I have ever observed are growing only a few miles from Tucson, on the foothills of the Santa Catalina Mountains, where hundreds may be seen growing on a single acre, many extending their huge green columns to the height of fifty feet. The many ribs which parallel the columns are surmounted by bunches of heavy spines. With great age the spines fall away from the lower portion of the plant, leaving the broad, obtuse ribs devoid of their natural protector. This fact led the first observers to report the plant spineless.

When lighted, the spines burn readily; the flame, soon ascending, burning the spines in its path until it reaches the top. From

this fact the plant is sometimes recognized as the "Arizona candle."

Just beneath the epidermis and alternating with the spiny ribs are strong ligneous fascicles. These fascicles are of the same number as the ribs, and serve as a support for the soft parenchyma tissue which constitutes the great bulk of the plant.

The fascicles are not unlike huge fish poles, twenty to forty feet long and from one to three inches in diameter, flattened radially as relates to their position of growth. This woody portion endures long after the other parts of the plant have decayed and is popularly known as the skeleton. During the growth of

A Cactus Forest.

the plant the fascicles increase in size each year by the addition of a woody layer to their outer surface, in the same manner as the oak and maple add their annual layers. The layers of growth forming the older fascicles are very close together, sometimes a hundred being crowded into less than an inch of space.

This portion of the plant is of great value to both Indians and Mexicans, as it not only serves as firewood but is extensively utilized in both fence and house building. When cut to requisite length it makes excellent pickets, and throughout its entire range the dirt roofs of the adobe houses are supported by the long, strong fascicles.

We find by counting the layers of growth that many of the

older plants have been more than a century and a half in growing. The size of the plant is not always a fair criterion of its age, as plants eight to ten feet high, growing from the granite rocks on the southern slopes of the Santa Catalina Mountains, are older than plants four or five times larger growing in deep cañons or in yards about the city, where the water supply is not so completely withdrawn. The ability, however, of this plant to withstand prolonged drought is very great. Its enormous mass of succulent tissue, protected by a thick epidermis, enables it to maintain the accumulated moisture for an almost indefinite period, even after every source of outside moisture has been dried up. A plant may be taken up, exposed to the hot, dry air for months, and when replaced in the soil continue to grow, having suffered little apparent injury. Living specimens, weighing several hundred pounds, may be packed in boxes and shipped to Europe and other foreign countries, without injury to their vitality. A few years ago a specimen some eight feet high was placed in the window of one of the Tucson shops. Some eighteen months later it was found on examination to still contain a large amount of moisture. Its vitality is further illustrated by the fact that a foot or more of the top may be cut from the plant in early spring and sent across the continent, flowers developing on the detached portion several weeks after it has reached its destination.

GIANT CACTUS (*Cereus giganteus*). (Engelm.)

A number of birds, including the Gila woodpecker, the red-shafted flicker, and the golden flicker, excavate great holes in the soft tissues in which they build their nests. Later the abandoned

houses of the woodpeckers are favorite retreats for the Mexican screech owl and the pygmy owl. An occasional bat, overtaken by sunlight, passes the day in one of these dark holes, and when the excavation extends through, from side to side, the cactus wren brings in its miscellaneous collection of sticks and straws and makes itself at home.

The first flowers appear when the plant reaches a height from eight to twelve feet, and at this time branches develop; usually forming a whorl a few feet below the summit. In the course of a year or two the branches assume an upright position, forming columns parallel to the main stem.

The large, waxy-white flowers are borne in the axils of the bunches of spines, at or a few inches below the summit of the trunk and branches; sometimes a half hundred crowning the summit of a single branch. They begin to bloom during the early days of May, and are not entirely gone before the middle of June. By midsummer the thick stems are loaded with ripened fruit, and the harvest time for both birds and Indians is at hand. The latter, mounted on ponies, pass from tree to tree, armed with long poles, with which they detach the fruit and bring it to the ground. The squaws gather it in baskets and carry it to their village, where it constitutes the staple article of food for the time being. The surplus is made into a preserve having the consistence of thick molasses, and is nearly as sweet. It is then packed in small *ollas* and put away for future use. Not always, however, is the surplus fruit put to this use, but instead is made into a rank, intoxicating drink.

The fresh fruit is not unpleasant, even to the cultivated palate, and is very unlike the slimy, mucilaginous fruits of many other species. At maturity they are fully three inches long and half as wide. In a few days the pericarp, or thick outer rind, splits at the summit into several segments, which, curling back, exposes the rich, red pulpy interior. The segments spreading in all directions appear from a distance like gayly colored petals. As they become more deflexed the central portion falls to the ground, leaving only the pericarp attached to the plant. The edible portion consists of the long, fleshy *funiculi* which attach the numerous small black seeds to the ovary.

Nearly a half hundred birds feed upon the rich, nutritious fruit of this plant, the list including all our thrashers, woodpeckers, finches, and pigeons. It is through the agency of these birds that the seeds become disseminated.

ESKIMO BOWS AND ARROWS.

By JOHN MURDOCH.

WHEN we landed at Point Barrow, in 1881, it seemed as if every Eskimo hunter had a pretty good rifle. There is a law against selling breech-loading arms and ammunition to "Indians," but it was no better enforced in Alaska than it was in old times on the plains, when the Sioux used to butcher our soldiers with rifles and cartridges made in the Eastern States.

When we grew better acquainted with the natives, however, we found that some of the poorer men were still obliged to depend on the weapon of their forefathers, the bow and arrows. Besides, every boy in the village had his little bow, which he used for shooting birds and small animals. Now, these bows were perhaps the most ingenious piece of bow-making in the world.

As every one knows, the Eskimos, with very few exceptions, inhabit a region which is perfectly treeless, or at any rate where nothing grows but pines and spruces, whose soft, inelastic wood is entirely useless for making bows. They have overcome this difficulty very effectively by fastening along the back of the bow twisted cords of reindeer sinew in such a way that each cord is stretched when the bow is bent and flies back when the bowstring is released. As far as we know, no other race of savages make use of this ingenious contrivance. Some tribes of Indians are in the habit of stiffening their bows by "backing" them with strips of sinew, glued on, but the Eskimo backing is made of cords and tied on. As old Martin Frobisher, the first Englishman who ever saw the Eskimos (in 1577), tells us, "Their bowes are of wood of a yard long, sinewed on the back with strong sinewes, not glued too, but fast girded and tyed on."

In some regions the Eskimos when first visited by white men were still using bows with a very simple backing, merely twenty or thirty strands of twine running from one end of the bow to the other, twisted together tightly from the middle, and tied down to the bow in two or three places. My friends at Point Barrow and along the adjacent coast, however, had gone on improving the bow until it was the best made by Eskimos anywhere.

The body of the bow was made of a piece of good sound spruce driftwood, from forty to fifty inches long, an inch and a quarter wide, and three fourths of an inch thick in the middle. It was very carefully and neatly made, trimmed down beautifully smooth with the crooked knife, the Eskimo's universal tool, with which he does such very clever whittling. Like all bows, they were flattened on the "back" and rounded on the "belly" and tapered off toward the ends, where they were worked into neat

"nocks" for the bowstring. Some bows were straight, and some turned up at the ends like a Tartar bow.

Now, to "back" such a bow as this they would take one piece of twine, forty or fifty yards long. This twine is made of a three-ply braid of reindeer sinew, about the size of common twine such as we use for tying parcels, and serves the Eskimos for a great variety of purposes. One end is looped round one nock of the bow, and about twenty strands are strung up and down the back of the bow, from one end to the other. Then they began to lay on strands that ran only between the weakest parts of the bow—that is, the points about half a foot from each end. Here these strands were fastened with very complicated hitches, making a sort of "whipping" round the bow. When there were enough strands put on to make a couple of cords about as big as a lead pencil, an ingenious tool was used to twist each up tight from the middle, and the whole was whipped down securely with the end of the cord. It is easy to see how drawing the bow would stretch these twisted cords and make them fly back with great force when the string was released, while all these lashings and whippings not only hold the cords tight to the bow, but also compress the fibers of the wood like the whippings on a fishing rod, and prevent cracking. The hitches and knots, besides, are put on in such a way that straining the backing draws every lashing tighter. The bowstring was also of the same plaited sinew.

The arrows were very neatly made of some light wood, and feathered with two or rarely three narrow feathers, generally made from the quill of some bird of prey, and neatly lashed on. They had four kinds of arrows. The bear arrow in old times always had a regular flint arrowhead, made by flaking, such as so many savages used, and which are found in such quantities all over the country wherever the Indians used to live. They still preserve the art of making these at Point Barrow, and made a number of beautiful arrow points for sale to us. But they never learned how to make a flint arrowhead with barbs, and so they sometimes made their bear arrows with a barbed head of bone tipped with flint. Driven by such a strong bow these arrows were very effective, and, if no bone was in the way, were sometimes driven clean through the body of a polar bear. As they came more in contact with white men, they took to tipping both kinds of bear arrows with bits of metal, brass, iron, or steel when they could get them. I brought home a couple of arrows tipped each with one blade of a pair of scissors, filed into an arrowhead.

For hunting the reindeer the arrow had a long, sharp, bayonet-shaped head made of antler, barbed on one edge and fitted loosely into the shaft. As the Eskimos told us, when they hit a deer with one of these arrows the shaft could drop out, leaving the

barbed head in the wound, and the deer would go off, "sleep one night, and then die."

Geese, gulls, and other large fowls were shot with arrows that had long, five-sided heads of walrus ivory, not very sharp and barbed on one edge, while for hunting small birds they used an arrow with a blunt, club-shaped head made of reindeer antler. Such an arrow kills a small bird or little animal like a lemming or ground squirrel by stunning it, and does not tear a great hole in it. The boys' arrows nowadays are often headed with empty copper cartridge cases, and I have seen one of these shot clean through the body of a small bird.

The bow was carried, strung ready for use, in a sheath of tanned sealskin slung across the shoulders in such a way that it could easily be drawn out under the right arm. Nowadays they carry their rifles in similar sheaths.

Attached to the sheath was a quiver, also of sealskin, in which they used to keep an assortment of arrows, some of each kind, according to the hunter's needs.

All the Eskimos draw the bow like European archers—that is, by hooking the fore and middle fingers round the bowstring, with the arrow clasped between the fingers, instead of pinching the butt of the arrow between the finger and thumb, like most Indians.

As the bow is now practically nothing but a plaything among the Eskimos of the Northwest, it will probably not be many years before it entirely disappears, as it has in Greenland.

PUTTING aside "supposed portraits" and such as might be termed "fancy portraits" having no claim to authenticity, Mr. W. Carruthers has satisfied himself of the existence of eight portraits of Linnæus that were evidently painted or drawn from life, and have been copied more or less frequently by different engravers. The earliest was painted by Hoffmann in 1737, while Linnæus was working for his patron, Cliffort, at Hartecamp, and represents him at the age of thirty in the picturesque dress in which he traveled through Lapland. Of the next portrait, an engraving by Ehrensverd in 1740, no original is known to exist. In 1747 two pencil sketches of Linnæus, forty years of age, one sketch being a full length, were made by Rehm. Five years later a fine pastel was executed by Lundberg. Scheffel, in 1755, painted him at the age of forty-eight; and this portrait was painted by Krafft, and was placed originally in the Medical College of Stockholm, of which Linnæus was one of the founders. It was supposed to be lost, but had been removed to the Royal Academy of Sciences at Stockholm, where Mr. Carruthers discovered it. The latest portrait was that by Roslin, painted in 1775, when Linnæus was in his sixty-eighth year. A fine copy of this by Pasch, presented to Sir Joseph Banks, and given by him to Robert Brown, hangs in the library of the Linnean Society.

WHEN CHARACTER IS FORMED.

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I.

THE results of late researches in physiological and experimental psychology contribute much toward a rational explanation of the causes of abnormal and deficient mental characteristics in childhood. To begin with, it is now satisfactorily shown that mental action is accompanied by the expenditure of energy derived from the breaking down of highly unstable chemical compounds in cerebral nerve cells. The brain has come to be regarded as a storehouse of nerve power; and when too severe or prolonged demands have been made upon it the cells become much depleted of their contents, and there results a condition of brain tire or fatigue. The process of depletion has been studied with great care in the case of the frog by Dr. Hodge,* of Clark

DIAGRAM A, showing changes observed in the nucleus of the living sympathetic nerve cell of the frog, as the result of direct electrical stimulation (Hodge, after Donaldson †). After six hours and forty-nine minutes of stimulation, the nucleus (*n*) is seen to be reduced to less than one half its size when the stimulation began.

University, and some of his results are shown in the accompanying Diagram A.

While no similar observations have been made upon human beings, for obvious reasons, yet it seems reasonable that the same law holds here in regard to the expenditure of nerve energy by physical or mental work.

It is evident that the law of the conservation of energy is implied in this phenomenon, and the accompanying diagrams may serve to make clear the method of its application. In Diagram B there is shown leading to the very heart of the nerve cell a filament, N, whose office is to carry messages in the form of stimuli from the world without; and leading from each cell are a number of avenues or passageways, D, through which may run off to other cells or muscles the energy set free by the advent of some sense stimulus or by the processes of thought and feeling. A very slight stimulus may in certain instances unloose a relatively

* For a detailed description of the method of making the study, with results, see Hodge, Some Effects of Electrically Stimulating Ganglion Cells. American Journal of Psychology, vol. ii, p. 3 *et seq.*

† The Growth of the Brain, p. 320.

great amount of energy which may be expended in thought and emotion, or which may issue directly in movement. Every one knows that a mere whisper of the death of a dear friend or of an approaching calamity or any similar circumstance will create great mental disturbance and drain the nerve cells to the point of exhaustion. So the prick of a pin or a tickling of the sole of the foot will produce vigorous movements of the entire body in most persons. It is probably true that in almost all instances the physical or mental resultant of a given stimulus is far greater, from the point of view of energy expended, than the stimulus itself. Every stimulus entering the cerebral cells is re-enforced from the energy stored therein; and it is plain, of course, that the less the supply or the greater the demands made the more rapidly will exhaustion follow. In a study, then, of brain fatigue in childhood we have to consider first the conditions which determine the amount of energy which shall be stored in the cells, which, as we shall attempt to show, differs in individual cases on account of a variety of varying circumstances; and, secondly, we have to regard the character of the work done, so as to notice how heavily it draws upon the credit of the brain.

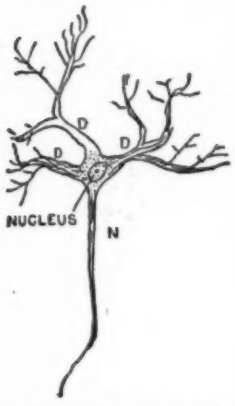

DIAGRAM B, from Starr, Atlas of Nerve Cells, page 39, modified especially to show nucleus which is depleted of energy when the cell is in action.

It is the purpose here to consider especially the intellectual and emotional concomitants of brain fatigue in childhood. In order to ascertain these we may employ any or all of several methods of inquiry. In the first place, we may make direct mental tests to determine if a child can think as rapidly and logically in a state of fatigue, occasioned by overwork or by lack of food, as when refreshed after rest or proper nutrition. In the second place, we may by introspection observe the effects of fatigue upon our own processes of thinking and the character and quality of our feelings. Third, we may study children in their everyday work and play, and observe the influence upon their thinking and feeling of prolonged periods of activity, of great excitement or overstimulation of any sort, of a lack of proper and sufficient food, and other like conditions. Again, we may by observation, and by experiment with apparatus,

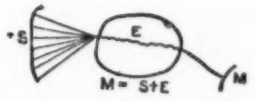

DIAGRAM C.—S = stimuli pouring into the brain (E) through all the senses, and issuing in mental action or movement (M). It shows that the energies of the brain are being drawn upon continually to re-enforce the stimuli from the outer world.

determine the effect of brain fatigue upon physical power and control and make inferences therefrom respecting thought and emotion, since there is little doubt that good physical control indicates a well-balanced and hence a well-nourished brain, which in turn is the essential requisite for well-balanced thinking and feeling. On the other hand, a lack of control in the body as a whole or special members thereof is indicative of an impaired state of the brain, and this impairment must interfere with vigorous, connected thought, and give rise to more or less abnormal feelings. It follows from these propositions that the character of an individual's movements is an index to his brain condition, and indirectly to his mental constitution, aptitudes, and possibilities.

As a result of considerable investigation * of late, according to these various methods of study, it has been shown that, as might be expected, fatigue interferes in the first place with the keenness and integrity of one's intellectual processes. The power of continuous attention is lessened, the rapidity and accuracy of perception through every sense are dulled, memory becomes halting and uncertain, and reason grows illogical and erratic. The writer has studied during the past year the influence of brain fatigue upon school children in Buffalo by observations made during the regular work of the day, and by simple experiments with apparatus designed to test first, the rapidity of thought and action as determined by the length of reaction time upon stimuli presented to the different senses; second, the keenness and accuracy of sense perception; and, third, the power of control of the body as a whole, and of the different parts, as the hand, the tongue, etc.† He has also tested the elementary intellectual processes according to methods devised by Dr. Joseph Jastrow, wherein the ability to perceive and judge of form

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* For detailed results of some of the most important of these researches, together with careful and complete descriptions in many cases of the methods of study employed, see the following: Cowles, Neurasthenia and its Mental Symptoms; Mercier, The Nervous System and the Mind; Donaldson, Growth of the Brain, pp. 277–323; Francis Galton, Journal of the Anthropological Institute, 1888, p. 153; Warner, Mental Faculty, p. 76; Dresslar, Fatigue, Pedagogical Seminary, June, 1896; Kraeplin, A Measure of Mental Capacity, Popular Science Monthly, vol. xlix, p. 756; Sinclair, Schoolroom Fatigue, Educational Foundations, May and June, 1896; Bryan, The Development of Voluntary Motor Ability; Gilbert, Studies upon School Children in New Haven, in Studies from the Yale Psychological Laboratory, vol. ii.

† It will not be possible here to give a description of the apparatus employed, with illustrations and details respecting methods of use, but the reader, if interested, can obtain complete information relating to most of the apparatus by referring to Scripture, *op. cit.*, as follows: For the apparatus used in testing rapidity of thought and action, see pp. 27–37; also pp. 43, 46, and 58. For the apparatus employed in testing the keenness of the senses, see pp. 101–112; also pp. 124, 135, 139, 141, and 170–173. For that employed in determining physical control, see pp. 67–74, 79, 80, 86, 87.

readily and accurately, to retain and reproduce visual impressions, and to identify new impressions similar to others recently experienced, is detected.* These experiments test in a way at least the processes of attention, perception, retention, and comparison or reason; and because of their simplicity, not being complicated with other factors, it is comparatively easy to detect varying power on the part of the pupil.

Space will not permit a detailed statement of the results of these studies, but it may be said in summary that after two and a half hours' work in the schoolroom almost all pupils show a decrease in intellectual power. Reaction time is considerably lessened—the pupil can not perceive and react so quickly or with such surety. He can not discriminate colors with such keenness. If in the morning he can detect a gramme pressure upon the back of the hand, he now requires two grammes or more in order to receive an impression. If when he is refreshed he can detect two points upon the back of the hand thirty millimetres apart, they must be separated considerably in order to be detected as two when he is in a state of fatigue. In a test of physical control the hand will be found much less steady after a few hours of mental labor, as may be seen by examining one's handwriting with a magnifying glass. If the pupil endeavor to perform some difficult task requiring great co-ordination of the different parts of the body, as in directing a light rod upon a small point a few feet away but yet within easy reach, or in threading a fine needle, the influence of fatigue is easily observed. In the laboratory a device is used whereby an electric bell is rung when a given point is not touched. In testing a pupil in this way it has often been found that he can not only not touch

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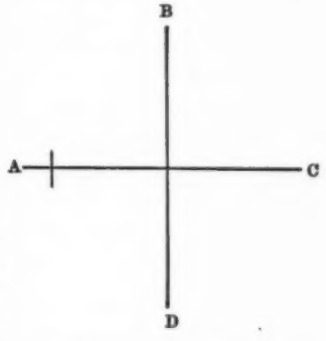
* The ability to perceive and judge of form is tested first by dividing a line of a given length, say three inches, into any desired number of equal parts; second, by marking off on lines B C D a distance equal to that on A; third, by singling out and marking a certain form, as ⅂, mingled in with many more similar forms, as ⊥ ⌈ ⅂ ⌊. This work requires considerable power of attention and discrimination.



Retention and reproduction of visual impressions is tested by having the pupil examine for about two minutes a card containing fifty pictures or words, each being accompanied by a number; then on a card containing ten pictures or words selected from the fifty the pupil is to set down the appropriate number opposite each, being allowed only a brief period for this—say one minute. To test the ability of identification the pupil examines for one minute a card with ten words or pictures, and then either immediately or some time after identifies and marks these in a group of fifty words or pictures.

the point so often in a state of fatigue as when rested, but the strain seems much greater upon the whole body, causing twitching and other choreic movements if continued very long. This evidence all points to the fact that mental activity expends nervous energy which is revealed in lessened muscular control. So in the direct mental tests, a pupil can not after a half day's work in school do such an apparently simple thing as to divide a line into a given number of equal parts with the accuracy that he can earlier in the day. The same effects of fatigue are evident in the lessened power of retention of visual images, and of identification of similar impressions. In short, fatigue lessens mental ability; produces, relatively speaking, dullness, stupidity, and inaccuracy in thinking.

Substantially these same results have been reached in experiments made by Professors Burgerstein,* of Vienna, and Kraeplin,† of Leipsic, and at Leland Stanford Junior University ‡ in our own country. Mr. Galton # has secured statements from adults to the effect that a hard day's work lessened the keenness and trustworthiness of their intellectual operations. They could not perceive so accurately, remember so readily, or reason so efficiently. Mr. Sinclair, ‖ in his studies of schoolroom fatigue, has obtained similar data.

The statement was made in a previous paragraph that people differ greatly in the readiness with which fatigue ensues upon mental effort. The nerve cells seem to be so constituted in some people that they give off an undue amount of energy upon slight stimulus.△ This fact may be easily observed in a group of children as well as among adults. A slight noise, a touch upon the shoulder, or a sharp question will cause some to react with an amount of vigor quite out of proportion to the degree of the stimulus. The body will twitch, the face flush, and the thought will be confused. Other children will show none of this excessive display of energy. Their reaction is proportionate to the stimulus, and in this way they save their energies. Consequently, other things being equal, they endure much longer and can undertake more difficult and trying ordeals without fatigue. Again, it is easy to see when any number of children are gathered together that some have much more energy always at their disposal than others. In other words, they are better nourished, which means in this connection that they have more nerve energy that may be employed in either mental or physical work. The important

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* See Kraeplin, *op. cit.* † *Op. cit.* ‡ Pedagogical Seminary, vol. iii, p. 213 *et seq.*
# *Op. cit.* ‖ *Op. cit.*
△ *Cf.* Bryan. The Development of Voluntary Motor Ability. Proceedings of the Department of Superintendence of the N. E. A., 1897.

point to be noted here is that some children, from whatever cause, may be in a more or less constant state of fatigue all or most of the time; and since fatigue produces what is called dullness, these unfortunates will be distinguished as dullards and stupids, unless the greatest care be taken in home and school to conserve their nervous energy. If such care is not taken, a chronic condition is established in the nervous system which permits the energy to escape in useless ways; and if this continues long enough, perhaps through the college period, it is doubtful if the individual will ever fully recover, since the nerve cells probably acquire their permanent modes of action by this time.

Thus far nothing has been said of the effects of fatigue upon emotional states. It is manifestly much more difficult, if at all possible, to obtain data respecting this question by scientific experiment; we must rely rather almost wholly upon observation. Doubtless every one has had sufficient experience to be assured that irritability is in many persons an almost certain consequence of unusually severe mental strain or worry.* It has already been pointed out that in a state of fatigue the nerve cells are unstable, giving off energy—exploding as it were—without sufficient cause. A person who when refreshed and vigorous would be able to inhibit impulses to anger, or quick words, or passion of any sort, would probably in a state of fatigue lose this power, at least in a measure. That is, fatigue in most instances lessens the inhibitory action of cerebral cells, and the individual reacts upon every stimulus without, as we say, deliberation or consideration. It is shown, too, by some investigators † that fatigue produces a melancholy, depressed feeling; causes one to turn his thoughts in upon himself, and to become morbid and gloomy if this self-consciousness is long continued. Further, it is the opinion of those who have had large experience that those qualities of character which are described by the terms vicious or criminal are due to perverted feelings dependent upon impaired physical conditions, ‡ especially of the nervous system. It has become a maxim that a man in a state of hunger is much harder to govern than when he is well nourished. Untruthfulness, which Kant has called the negation of self, is generally a characteristic of an individual who has not vigor enough to face boldly the consequences of his acts. It would doubtless be within bounds to say that in general one who is physically weak, who is nervously depleted, is usually, although perhaps not always, morally weak.

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* *Cf.* Warner, *op. cit.*, p. 76. † E. g., Beard, Cowles, Dresslar, *op. cit.*

‡ See Collin, Papers in Penology, 1891, pp. 27, 28; also Wey, in same, pp. 57–69; Wright, American Journal of Neurology and Psychiatry, vols. ii and iii, pp. 135 *et seq.*

Dr. Stanley Hall has said somewhere that the time may not be far away when we can say that what is physiologically right is morally right—that is, whatever begets the best physiological conditions will produce the best moral character.

II.

If brain fatigue interferes with the readiness and accuracy of one's intellectual operations and estranges the emotional nature, it is important to know what are the agencies most commonly found in home and school which produce this condition; for when the various qualities of which dullness and irritability are types are characteristic of one's childhood they tend to become permanent, thus determining one's character. It is shown by neurology that any mental act oft repeated leads to the establishment of correlated neural processes which make the reproduction of that act continuously easier until it becomes automatic, when all the causes which originally produced it even if with conscious effort on the part of the individual will in time awaken it without any such difficulty. If now it be remembered that brain fatigue is due to some degree of exhaustion of cerebral cells, it will be apparent that one of the most important sources of fatigue is inadequate nutrition of the brain. Nerve cells, like all other cells in the body, repair themselves by absorbing from the blood those materials suited to their particular needs. If the blood does not carry to them a sufficient quantity of the right elements of food to meet the demands made upon them, then while thus neglected they will be in a partially exhausted state from sheer inability to obtain nutriment. Just so a field of wheat in poor soil will bring forth imperfect grain, or a fruit tree unable to find the proper elements of nutrition will bear defective apples or pears or peaches.

All life of whatsoever kind requires a proper sort and adequate amount of nutrition in order that it may develop in a vigorous, healthy manner. Experiments have been conducted in rearing tadpoles and pond snails in various sized vessels of water, where the opportunities for nutrition corresponded with the quantities of water inclosed, and it has been found that the less the amount of water the smaller the animal. Animals reared in this way may be arranged in a series increasing in size according to the quantity of water in which they have been placed.* Many mammals and birds are found to have their centers of distribution in the northern regions, and they diminish in size from the northern to the southern latitudes, thus indicating that the ability to obtain food determines the degree of development of the bird† or

* Donaldson, *op. cit.*, p. 139.

† Ibid., p. 59.

animal. Bowditch * has shown in his studies upon the growth of children that native-born Americans are larger and better developed than those of foreign parentage, and ascribes the reason to the better conditions which surround the American children. So children from the non-laboring classes are larger than those from laboring homes.†

While these data show only the dependence of physical development upon nutrition, still we are not without similar evidence showing that mental development depends also upon the character and amount of a people's food. The causes for the intellectual and temperamental differences between the races of different countries may be ascribed, at least in part, to the character of their dietaries. Contrast the Chinese and English, for instance: the former are mentally and emotionally very different from and inferior to the latter, as might be expected from the quality of their food. The difference between these two races is typical of the difference between types of children to be seen frequently in home and school. The one is slow and obtuse intellectually, and possessed of an indifferent or negative emotional and moral nature; while the other is keen and vigorous in thought, and positive in emotions and morals; and one who strives by concrete observation to account for these differences can not fail to see plainly ofttimes that they are due to the quality and quantity of food which the children eat.

It is important to note that cerebral nerve cells demand particular materials for their proper nutrition. Food which will make bone will not be best suited to the nourishment of an active brain, and *vice versa*. So fat-producing foods, while of course of value in one's diet, yet do not furnish in large measure nutrients for the repletion of nerve cells. Prof. Ladd says that the chemistry of the nerve cells is in the main protoplasmic, and therefore rich in albuminous bodies.‡ And again, "Of the solids composing the nervous substance, more than one half in the gray and one fourth in the white consist of proteid or albuminous bodies."* The foods that are best calculated to nourish the brain, then, are those containing a large amount of protein or albumin, rather than fats, carbohydrates, or minerals, the three other important constituents of foods. But in many homes, as well in those of the rich as of the poor, the children's dietaries contain comparatively little albuminous food, as may be seen from the following analysis of the nutritive values of the various common articles of a child's diet: Beef contains 29·7 per cent of protein; chicken, 19·3 per

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* Eighth Annual Report of the Massachusetts State Board of Health, p. 295.

† *Cf.* Herbert Spencer, Education, New York, 1884, pp. 226, 227.

‡ Outlines of Psychology, p. 15. * Ibid., p. 12.

cent; fresh fish, about 16 per cent; salt cod, 27·6 per cent; rolled oats, 16 per cent; wheat flour, 12 per cent; Graham flour, 14 per cent; beans, 22·2 per cent; while such vegetables as beets, cabbage, corn, celery, lettuce, potatoes, tomatoes, squash, etc., contain on an average not more than 1·5 per cent of foods that nourish the brain. Pie, pudding, cake, cookies, and crackers contain at the outside not over six to seven per cent, even when these are so cooked that the little substance they contain may be extracted in digestion.* The writer has ascertained the bills of fare of many school children by direct observation and by having them write out the customary articles of diet with mode of cooking, and he has found, what is doubtless already well known, that in many homes the children live quite largely upon vegetables, white bread, and pastry and cakes of various kinds. Parents are oftentimes satisfied if their children eat a large amount of such things, thinking it is primarily the quantity, not the quality, which is to be considered in securing nutrition. As a consequence, those children that live largely upon a starchy diet are in a more or less constant state of brain exhaustion, and they will be liable to manifest all the evidences of fatigue which have been described in preceding paragraphs.

It happens frequently in the homes of the well-to-do, where the expense can have nothing to do with the matter, that the children are permitted to live almost wholly upon those foods which seem to delight the palate, as cookies and cakes in a variety of forms, but which contain relatively little nutrition, the principal ingredient being starch in the form of wheat flour. It is the practice often to begin in the early months of a child's life to feed it highly seasoned and sweet foods, thus establishing an appetite which later is not satisfied with the simple nourishing meats, grains, and milk. In the poorer homes, in our cities particularly, many are unwise in the expenditure of what money they can spare for food, purchasing mainly starchy foods, which, although of relatively little value anyway, are yet more suited for the adult engaged in out-of-door labor than for a child at mental work in school.† Usually in such homes children eat the same food that

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* Dietary Studies at the Maine State College in 1895, published by the United States Department of Agriculture, Bulletin No 37, pp. 11–17. See also Prof. Atwater's Analyses, published by the Department of Agriculture, Bulletin No. 23; and Meats: Composition and Cooking, Bulletin No. 34.

† Atwater (*op. cit.*) gives quite a number of dietaries showing how money may be spent to greatest advantage in poor homes. Atkinson, in his Science of Nutrition, pp. 11–65, Springfield, Mass., 1892, also discusses the subject quite fully. An attempt is made by both these authorities to state just what proportions of the different nutritive elements a child's dietary should contain at different ages, but the results are nothing more than suggestive, for children differ greatly in their needs. A highly organized, nervous child, working hard

is prepared for the father of the family, whose labor involves only the use of his muscles, and greater thought is taken in providing for his needs than for those of the children. And then so slight attention has been given by most people to the subject of foods for human beings, although many intelligent men pride themselves in knowing what is best for their horses and cattle, that they do not discriminate between the relative values of different articles. For the most part our tables are thought to be abundantly provided for when they are supplied with a large quantity of food, even though this be of a non-nutritive character, considering the special needs of those who are to partake of it. The art of cookery, too, is so little developed among us that even when food has potentially nutritive value it is not infrequently destroyed in the process of preparation, or is rendered so invulnerable that the stomachs of the children are too feeble to have any effect upon it. Either or all of these conditions are sufficient to keep the brains of many children poorly nourished, and as a consequence such will show evidences of dullness and of the various temperamental disturbances which accompany a lack of proper nerve nutrition.*

That imperfect nutrition is the cause of much of that emotional estrangement in childhood which is called irritability, ugliness, viciousness, or something of that sort, has been satisfactorily evidenced to the writer as the result of a number of observations which he has been able to make upon young children. The following case is typical of many others: H—— was a well-formed child at birth, and continued to develop normally during her first five months. Throughout this time she slept very well, and for the most part seemed happy and contented. The constant expression on her face showed healthy feeling, and she rarely made a disturbance. At about the fifth month a change seemed to gradually come over her. She did not sleep so well; the expression on her face showed less happiness and contentment, and by the sixth month she could be called an irritable and peevish child. She who had been previously an especially happy child did not now smile often; and the things which ordinarily attract children of that age seemed to be of little moment to her. Some member of the family was now kept busy much of the time endeavoring to soothe her troubled spirit. This state of affairs continued until about the eighth month, when it was decided to make a change in

in school, requires much more nerve nutrition than one of a phlegmatic temperament who may be leading an easy life at home. Temperament is an important factor in this matter of nutrition. Spencer (*op. cit.*) has some excellent things to say along this line, pp. 214–235.

* *Cf.* Warner, *op. cit.*, p. 81; Krohn, Child-Study Monthly, vol. i, No. 10, p. 565 Holmes, Transactions of the Illinois Society for Child-Study, vol. i, No. 1, p. 205.

the diet. She was given a food rich in materials to nourish the nervous system, and within a week it was observed by all who knew her that there was a marked improvement in her temperament. After two weeks of proper nourishment she had regained her former restfulness, sleeping peacefully a good portion of the time; and gradually the expressions of irritability and moodiness disappeared. Her face would now light up as formerly with pleasant smiles whenever any one she knew was about, and once more she appeared to every one as a very good-feeling, happy child. From that time on care was taken with her food, keeping it rich in albuminous elements, and her intellectual and emotional development was most satisfactory in every way. Some time after her diet was enriched it was learned definitely that the food she had been getting just previously was quite deficient in nutritive elements.

Brain fatigue in childhood, as physicians well know, is sometimes due to pathological conditions wherein the peculiar elements needed to nourish the brain are not assimilated from the food. X—— and Y—— are two children of the same family, who at the ages of five and seven respectively came under the writer's notice. They were then giving their parents a great deal of trouble. They were highly organized, irritable children, with whom no one seemed to get along pleasantly. While at home nothing was permanent in its interest for them, and discipline was a serious problem. When they began going to school matters grew worse. While apparently bright children, they did not make rapid progress, and always seemed utterly fatigued at the close of the day's work. When they reached home at night any little thing which crossed their paths would so greatly annoy them that they were much of the time in tears and passions. After every effort had been made by the parents to discover what was the matter, an analysis of the blood was finally decided upon, and it was found that it lacked the right proportion of elements to properly nourish the nervous system. A special diet was then begun, and other treatment resorted to to supply this deficiency. After seven months of this special care sleep had been largely restored, the tendency toward irritability had decreased, and the children could now remain in school all day without becoming unbalanced thereby. They were in reality quite different children—keener intellectually, and expressing more estimable traits of character.

Lately a group of similar cases has come to the notice of the writer. The members of a family for several generations have been afflicted with anæmia of the brain, and the children show easily all the evidences of cerebral fatigue. One girl of twelve is characterized by willfulness and carelessness, as her teachers say.

She is an irresponsible child, acting upon every impulse without much regard to the outcome of her actions. This lack of inhibition or forethought or considerateness is characteristic of her intellectually as well as temperamentally. One day she may do fair work in school, and the next day fail utterly, being apparently attracted by everything but the work before her. She would pass in most schoolrooms as a stupid, willful pupil. A cousin, a boy of seven, has somewhat the same qualities. He fatigues more readily than other children of his age, and when in this condition he is impulsive, quarrelsome, and even vicious toward his companions. His attention wanders in school, and while bright in some ways, he has little power of continuous application to hard work. He is spoken of by his teachers as a "peculiar" child, a term so extensively used as a cloak for ignorance respecting the causes which make one child different from another.

III.

Imperfect nutrition is not the only source of brain fatigue in childhood. When the energy of the cerebral cells is consumed too rapidly by overwork, worry, or intense excitement of any kind, the same unhappy effect is produced. One would not expect to find any of these brain-fatiguing conditions in the golden age of childhood, since one would think the struggle for existence with its terrific strain in our day might be left until later life, where doubtless it must be encountered by every individual. But while our children may not be troubled by the social and financial problems of daily life, yet in many homes and schools, especially in our cities, they are from the cradle up subjected to continual over-stimulation, which is as inimical to the right development and hygiene of the nervous system as the whirl of society or the crush of business. According to the American fashion in most households, infants of a few months as well as children of maturer years are permitted to be in the presence of the older members of the family much of the time. Guests always expect to see the baby, to hold it, and to stimulate it in all sorts of ways to see how prettily and intelligently it reacts. This practice would not be so objectionable if it were not that when the average adult has a little child in his arms he is always intense and restless in voice and actions. Few people seem to appreciate how such treatment taxes the nervous strength of an infant. But let an older person imagine what a strain it would be to have excited people about him constantly, tossing and patting him, and making all manner of facial and vocal demonstrations for his entertainment. How much more it must wear upon a child to whom these things are new and strange, all arous-

ing the strongest emotions of fear, curiosity, or excitement, and thus draining the plastic, immature brain of its vitalities! In some homes it is quite the custom to allow a little babe to be freely handled by strangers of whom it is afraid; and then we wonder why in later life our children are the victims of a vast brood of fears which sap the energies and curtail the pleasures and usefulness of life in every direction.

It is not alone the trials of meeting strangers that are extremely fatiguing to young children, but the experiences with parents and other members of the family are often as exhausting. The young child, with its fresh, innocent ways, is not infrequently regarded as a plaything for the entertainment of its elders, and so is teased and tormented in all sorts of ways because its response is so novel and interesting. Of course, parents would not call such treatment teasing, but that is precisely what it amounts to from the child's standpoint. Just recently the writer was witness to a scene which is typical of much that may be observed in one's environment if he has an occasion to look for it. A little child disliked very greatly to have anything touch its nose, and would make the liveliest efforts to dispel whatever came in contact therewith. The sweet baby movements were naturally enough very amusing to an adult who did not see anything in them but fun for himself. Frequently some mature person who knew the child's characteristic in this regard would place a finger or other object near the delicate member to see the little one strive with arms, head, and body to drive it away. On one occasion a grown woman, whose years should have taught her better, was seen to tantalize the child for two or three minutes, finally throwing it into a state of fatigue. When it grew restless and began crying it was grabbed up, tossed and thrown about, and talked to in a loud voice. This violent stimulation overcame the child's impulse to cry for the moment, but had the effect to further fatigue it, which was shown later in continual crying until it fell asleep. If one will think of such things going on day after day throughout the early life of a child, the irritable, unbalanced, disagreeable children of one's acquaintance may be accounted for at least in part.

The writer has had opportunity to study with some care the effect which a lady with high-pitched, nervous voice and intense nervous face and manner, but otherwise of most estimable characteristics, had upon a little child, H——. Whenever she was near H—— she insisted upon taking her, and she thought the proper mode of entertainment was to shake and toss and pat her, and to make a great amount of noise and fuss over her. As a consequence, a half hour of such treatment was enough to fatigue H—— for a whole day, and her disposition at such times would be quite changed from a happy, good-natured child to one easily

irritated and satisfied with none of her ordinary pleasures. A nervous, irritable parent will breed these qualities in his children, because his personal contact will overstimulate them and they will be in a state of chronic fatigue. Such a parent will be apt to nag his children, to be constantly forbidding or commanding, and this arouses emotions which draw off the energies from the brain very rapidly. Antagonism is a breeder of nerve fatigue, and some children seem hardly ever to be free from it during waking hours.

Again, in many homes older children make the life of the smaller ones wretched much of the time. The writer knows a family where there are three children, the youngest about two years of age. The older ones seem to find no greater pleasure than to tease the babe on every opportunity, for she occasions them much merriment by her violent vocal and bodily expressions whenever she is tormented beyond endurance. One does not need to remain about this home long before seeing plainly that this child is being worried into an ugly disposition. Even at two years she has reached the point where she is intolerable much of the time, showing her unbalanced condition by flying into a passion over every little thing that occasions her displeasure. The attitude of the older children serves to keep her in a more or less constant state of fatigue, and the actions performed in this condition are rapidly forming habits, thus determining her character.

The evil effects of overstimulation are evident also in the attempts of parents and teachers to hasten as rapidly as possible the intellectual development of the children under their care. It has come to be regarded as desirable that a little child should begin hard work in school at five, and keep it up continuously until the college course is completed. Many think it creditable to a child to be precocious in his learning, and so he is encouraged to sit still and study instead of being spontaneously active in play much of the time. He is subjected in school to the great strain of appearing before his elders in "speaking pieces," etc., all of which tends to overstimulate, and hence to fatigue easily and unnecessarily. There is in our midst a feeling that maturity ought to be reached as early as possible and by the shortest cuts, but science shows that excessive rapidity in development is secured at the expense of mental health and attainment of the highest ultimate ends.* It assures us that too early and rapid organization of the nervous system through undue stimulation or educative influence of any kind finally results in arrested growth. Precocity is usually succeeded by mediocrity, if by nothing

* *Cf.* Spencer, *op. cit.*, p. 262.

worse.* It is significant that those races that are most precocious are ultimately the least intelligent and progressive,† more nearly resembling the lower orders of animal life, where the young possess at birth nearly all the powers they ever attain, and so are not educable to any great degree. It is to be feared that overstimulation in numerous ways of children in American homes and schools leads to early cessation of, and hence to an ultimately inferior, physical and mental development.

THE SCOPE OF BOTANY.

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WE hear much talk nowadays about the new chemistry, the new psychology, the new theology, even the new woman. It is not my purpose to present in this paper any remarks which could be styled "the new botany," for I hope that there is no new botany. Every department of human inquiry should be plastic enough to be modified by increasing knowledge, it should open new fields for investigation, and its members should increase in power. I feel that botany has been plastic, that the science has grown through the years until now it has not merely men who are actively seeking its development, but also those who are seeking for knowledge in ways and by means that have never before been employed, seeking for a knowledge not of facts only—interesting as many of these may be in themselves—but seeking in these facts, painfully and slowly accumulated, the evidences of deeper things, of the great principles which govern the world. The definition is a familiar one—"botany is that science which seeks to answer every reasonable question regarding plants"—and to many people botany is nothing more; but I should not venture to write upon this topic had I nothing more to say than this. The botanist regards his plants not as an end, but as a means of learning a little more about life. The human physiologist was the first to try to penetrate the mystery of life; later the animal physiologist, studying lower forms than man, attacked the same problem; and still later, only within the last hundred years one may say, the vegetable physiologist has come to the aid of the other two. All three, studying the manifestations of life, are

* *Cf.* Porter. The Physical Basis of Precocity and Dullness. St. Louis, 1893.

† *Cf.* Christopher. Handbook of the Illinois Society for Child-Study, vol. ii, No. 2, pp. 109–114.

seeking to solve the puzzle, What is life itself? With such an aim, the science of botany is more than a pleasant recreation for a summer holiday, it is more than a little accomplishment which can be taught in a finishing school for girls, it is even more than the sentimental or the poetic or the artistic contemplation of the beautiful as displayed in the rose and the lily. The botanist is devoting his time, his energy, his ability (if he has any) to the study of plants not because "it must be so lovely to be always studying flowers," as I have heard so often to my great discomfort, but that he may learn something that will help his fellows in their everyday lives, give them some truer notion of the physical life, and reveal to them some of the principles that underlie it all.

This sounds very fine, but how is the botanist doing all this; and what is the evidence that he has even begun to do some of this? The beginning of botany in this country, so far as the white settlers are concerned, was coincident with the first exploring expeditions, when the hardy pioneers made note of the vegetation, whether it was luxuriant or sparse, whether the plants were poisonous, useless, or useful. That even then a better and more general knowledge of the flora was deemed important, is proved by the record that at the college at Newtowne, founded in 1636 and now known as Harvard University, the study of plants was part of the curriculum in every summer term. To learn the names and the striking properties, useful or harmful, of the plants of a new country is the most natural endeavor of those who are to make it their home. From that time until now, it has been the custom to teach in the schools, and in many of the colleges, just these things. Because most of us go no further in our study of plants, we conclude that this must be all. The school boy and girl painfully learn the descriptive nomenclature, as we find it set forth with wonderful clearness in Gray's Text-book of Botany—that leaves are linear or obcordate or punctate with pellucid dots; that stamens are distinct or hypogynous or tetradynamous; and then they find that the bird-foot violet is technically known as *Viola pedata* and the lily of the valley *Convallaria majalis*. But the school boy and girl have thus simply acquired one means of learning more of Nature. Botany is not a science of names, a science overloaded with names though it may be. The individual who destroys a flower by tearing it to pieces (analyzes it, as the ladies say), and finds by the aid of some tiresome artificial key the Latin name of the plant which bears it, has conquered the difficulties of the botanical alphabet; but until he goes further he knows absolutely nothing of the literature of Nature. Children now learn to read before they learn the alphabet, and in many of our better schools the pupils begin to study

plants before they learn the descriptive terms applied to them. To have a knowledge merely of the names of plants is to possess a series of jug-handles without the jugs or anything in them. The handles belong with the jugs, and jugs should have, at times at least, something in them. Now, the truly scientific man who seems to be devoting his time to acquiring a knowledge of the names of plants, is in reality learning much more about them. He sees that plants of different sorts resemble one another in greater and less degrees. Those which resemble one another, not merely in superficial characters, which may be due merely to like conditions of growth and life, but in the more fundamental and less obvious characters, he assumes are related; and his studies lead him to formulate a classification which shall indicate in what ways and in what degrees the different plants are related. So we see the first step in the development of botany, the study of plants with a view to arranging them in some classification which shall subserve the convenience of students and at the same time indicate the relationships of plants to one another. But the word relationship implies something more than superficial resemblance. The resemblance is an index of descent. The older botanists—Jussieu, Linnæus, and others like them—believed that plants are now as they were created—created either at the beginning of the world or brought into existence later by separate acts of creation. The more critical observations of later years have shown that no two plants are exactly alike, that the offspring are not the duplicates of the parents, that plants are constantly changing as organisms and as generations of organisms. Certain influences cause certain changes; the different conditions to which plants are exposed in sunny and shaded, in moist and dry, in exposed and sheltered positions—the climatic, the geological, the geographical conditions—all have their effects. And so the study of plants extends from the examination of those just about us to a comparison of these familiar forms with those in other localities. There develops the science of geographical botany, which seeks to penetrate the reasons for the existence of certain plants as characterizing the North American, the central European, the Australian, and other floras.

In order to solve the problems thus encountered, the botanist must know not merely the present geographical and geological conditions of our globe, or of that part of it which he especially studies, but also what its geological history has been. This throws light upon many questions. For example, the North American flora is much richer than that of Europe. We gain some idea as to the reasons for this when we realize that the last ice period made much of Europe and of North America uninhabitable, as well for plants as for animals. All were compelled to migrate

to the southward or to perish. The Isthmus of Panama and the broad expanse of Central America offered a refuge for the tender forms which could not withstand the rigors of the Ice Age when North America was covered to the Ohio Valley with a great continental glacier. In the milder climes many of them survived, and as the ice retreated they slowly followed it—how, I shall take occasion to show in a moment. But between the ice-bound continent of Europe and the warmer lands to the southward intervened then as now the broad expanse of the Mediterranean, which could be traversed but by few animals and by still fewer plants. Many forms perished, and their places are empty to this day. Hence we see one reason for the greater number of plant species on our own continent.

The botanical geologist finds other things to study, for there are many plants of bygone ages preserved to this day as fossils in the rocks of various horizons. The science of paleobotany grows more slowly than the science of paleozoölogy, which greedily usurps the name of paleontology, as if plants were not quite as important, had not contributed quite as much of value to the earth's crust, as animals. The reasons why paleobotany is such a slow-growing and fragmentary science are two. In the first place, as I have suggested, paleontologists devote themselves in their investigations and teaching too exclusively to animal remains, and hence he who will know more of the plants of past ages must study and learn largely unaided. But the second reason is more fundamental—namely, that plant structures are less easily preserved than those of animals (whose shells or other hard parts are very resistant), and hence many have been destroyed during the various changes that the rocks in which their remains were imbedded have undergone. The fossil remains which are now known give confirmation of the fact mentioned a moment ago that plants are ever changing. The plants of the Carboniferous Age were very different from those of to-day. The aspect of field and forest then must have been mysterious indeed; the heavy atmosphere, the intense light, the moisture, contributing to a vegetation of more than tropical luxuriance. Between the lofty stems of tree ferns, in the deep shade cast by their great fronds, wandered animals hideous to the eye, though perhaps no more dangerous than our mild-eyed cows. But we find to-day, growing here and there, plants which greatly resemble those of the coal measures, not only the ferns, but the horsetails (scouring rushes of our ancestors, *Equisetum*), the Lycopodiums, without which no northern Christmas festival is quite complete, and others less conspicuous. These the paleontologist convinces us are the direct descendants of those plants which compose our coal. He thereby adds his facts to that history of life which shows that plants are related,

that they have common ancestors, that they have developed through the ages until now.

Another field of botanical study is being cultivated by those who devote themselves to the investigation of the adaptations of plants to their surroundings. The adaptations are so many and so perfect that all are tempted (and many yield) to let their sentimental imaginations replace that spirit of critical inquiry without which no scientific work of lasting value can be done. The adaptations for disseminating seed—the winged fruits of our maples, elms, and lindens, for example, or the silken parachutes of the dandelion and the milkweed, the explosive touch-me-not, and the wild crane's-bill with its boomerang—show one how a region devastated by glaciers, fires, or floods can be repopulated. The relations of flowers to the insects which are to pollenate them were first discovered by Christian Conrad Sprengel, and described in a now rare and highly prized book, The Secret of Nature Revealed; but botanists left Sprengel and his secret to themselves. Darwin rediscovered the secret, then discovered the book, and since then the world has been deluged with writings good and bad on this most fascinating subject. The whole field of phytobiology, the adaptations of plants to their surroundings, is open to every one whose interest in Nature takes him into the fields and woods—even into the public parks. No knowledge of technical terms is necessary to enable one to pull apart one of the great horse-chestnut buds, to notice the water-proofing varnish on the outside, the scale armor just within, the soft, downy padding which protects the minute leaves and the tip of the stem from sudden changes of temperature, to see that leaves or flower cluster are already formed in miniature ready to burst their coverings when the favorable time shall come.

The minute internal structure of the plant is as important a subject for investigation as the more evident features of which I have just spoken. The microscopic study of plants leads one to the most fundamental questions in biological science. It was in consequence of the microscopic studies of a botanist that it was discovered that all organisms are composed of cells, that these cells are essentially minute masses of a viscid substance—protoplasm—which is "the physical basis of life." Is it any wonder, then, that men have devoted their lives to its study, seeking through a knowledge of its structure to learn something of the life of which it is the physical, tangible embodiment?

Among plants as among animals there are two modes of reproduction, the sexual and the nonsexual. Higher animals reproduce themselves only sexually. Some of the higher plants reproduce themselves in the wild state nonsexually as well as sexually, as, for example, the blackberry by its runners, the pop-

lar by those saplings which develop from underground parts often quite distant from the parent trunk; and most of the higher plants can be reproduced in cultivation by cuttings, slips, etc. The sexual reproduction has been developed from simple forms in low plants—for example, the seaweeds—to a state of complexity among the flowering plants which is equal to that among the higher animals. Though there are no superficial resemblances between the sexual reproduction of animals and that of plants, yet the processes are intrinsically the same. The differences are mainly superficial, like those in the means of conveying the male elements to the female elements. The male and female elements in plants are very different from one another, just as in animals, much more different from one another than these elements are from the corresponding elements among animals. In the one kingdom as in the other fertilization takes place when a male element fuses with a female element. So much alike indeed are the microscopic processes in the two kingdoms that much light has been and still may be thrown upon the great general questions of the influence of parents on offspring, of heredity, of descent, of development, by the microscopic study of the phenomena of fertilization and development among plants. There is, therefore, a science of embryology cultivated by botanists which is of almost equal value to man with the science of embryology cultivated by zoölogists.

The microscopic study of the purely vegetative as distinguished from the reproductive parts of plants reveals certain mechanical principles of structure which engineers are now just beginning to follow in their buildings, especially those constructed of materials which in large masses resemble in physical qualities those microscopic elements of which plant structures are composed. We see that the stems of our native trees and those of the palms and others of warmer climes are really frames consisting of long, slender, light yet strong and elastic beams so joined together that they form a structure capable of supporting great weights in spite of the force of gravitation, and so buttressed at points of branching and where the aërial structures spring from their strong foundations in the soil that they are able to resist the really tremendous strains brought to bear upon them by high winds. These principles of buttressing, of accurate balancing, of avoiding sharp angles by the substitution of curves, of a light, elastic framework of great strength, which are common to all the larger plants, we see employed in those buildings which by reason of height, position, or purpose are exposed to great strains. For example, there is more than a fancied resemblance between the Eiffel Tower and the steel lighthouses of our coasts to the buttressed, spreading bases of our elms.

The study of structure, whether macroscopic or microscopic, leads one naturally to investigate the functions of the parts. The study of functions is physiology, and since we have given up the older notions as to the sacredness, the supernaturalness, of the phenomena of life in favor of the more rational view that they are chemical and physical, all physiologists to-day are pressing forward, with chemistry and physics as their allies, to larger knowledge and clearer ideas as to what constitutes life. Far as we still are from a solution of the riddle of the ages, yet during the present century progress hitherto unequaled has been made. Animal and vegetable physiologists are now going hand in hand toward their common goal. In studying the processes of nutrition, growth, reproduction, and the phenomena of perception, reaction, and exhaustion, they are supplementing one another. There are indeed some few physiologists of training and disposition so broad that they decline to be known as animal or as vegetable physiologists, but wish to be called what they really are, students of the functions of living organisms and seekers after light from whatever source upon life itself. The more one studies the physiology of animals and plants the more one sees that the distinctions which have been made between the two are more apparent than real, and that as in so many other cases our names are for convenience rather than for the exact expression of the truth.

The physiologist finds that there are two great classes of plants: (1) Those which, able to obtain from the crude materials of the soil and the air all the elements which they need for their nutrition, lead self-dependent existences; and (2) those which, unable to elaborate their food from such matters, must get it from other organisms, either directly or indirectly. All animals depend ultimately for their food upon those plants which are able to elaborate living matter from lifeless mineral salts, water, and air. But there are quite as many plants which are as dependent as animals. The groups of parasites, the flowering and the flowerless, the dodders and many of the fungi and bacteria, for example, are absolutely dependent upon living organisms, either animal or vegetable as the case may be, for their food. Other plants extract from the dead and more or less decayed remains of organisms the highly elaborated nitrogenous and carbon compounds which are essential to all life. Still others are fairly independent, but supplement their self-made food by other means; for example, the whole group of insectivorous plants and several of the orchids. The saprophytic plants, those living on dead organic matter, are very important in the economy of Nature. They accomplish rapidly, and with much less damage or offense to other organisms, the decomposition of otherwise waste matters which

could be removed, but slowly by the processes of chemical non-vital oxidation. Even the parasites are not wholly evils, for some of these man has already tamed and compelled to perform some of the most important domestic operations—the raising of bread and the making of cheese and vinegar. Alcohol is one product of the activity of yeasts, and to these we owe our wines and beers. The precision in the manufacture and the uniform quality of the product of bread, cheese, vinegar, and beer have come only within recent decades when the microscopic organisms upon which these processes depend have become known and regularly raised like wheat and cattle. Recent investigations plainly suggest that greater precision and more uniform success can be obtained in the production of wines and in the curing of tobaccos. Doubtless we have but begun to domesticate the plant parasites which can be made useful to man, and more extended investigations will probably show that many processes in the domestic and other arts which are now tardy and uncertain can be carried on rapidly and accurately.

The science of bacteriology has now become so specially developed along medical lines that in this aspect it can scarcely be counted longer a part of botany; but we should not forget that the first knowledge of the bacteria came through botanists, and that the methods now employed in studying and combating them were first suggested by botanists, and every teacher of botany should regard it both a duty and a privilege to spread among his pupils and the public in general such a knowledge of the habits and effects of these minute organisms that public sentiment will demand not only personal but municipal cleanliness. An adequate supply of water, free from contamination at its sources and in its passage to our houses, contributes not only to the comfort, but greatly also to the health, of any community. The installation of a system of sewerage, for the safe disposal of the extremely dangerous waste matters of houses and stables, will come as soon as public sentiment is enlightened as to the probability of fatal disease resulting from the infection of drinking water, milk, and other uncooked foods from such decaying matters. It is now known that street dust contains millions of organisms which, when they find lodgment in human bodies, made suitable by weakness for their growth, cause the most malignant maladies. Even the dust of our rooms contains numberless organisms of these same sorts. So it behooves us as intelligent people to strive to bring about such cleanliness of streets and houses that these dangers will be reduced to a minimum.

The bacterial and fungous diseases of other animals than man, and the diseases of plants, are still being studied by botanists. We have only begun to know the dangers which menace the

farmers' crops and stock. To study these dangers, to devise means to avoid them, to discover cures for those plants which are attacked by disease, are the tasks which the vegetable pathologist has before him.

Agriculture and horticulture are simply the practical applications of principles defined by the study of vegetable physiology. Questions as to the suitability of certain soils for certain crops are answered by the practical farmer, who scorns the aid which the scientific man might give him, by such expensive experiments as sowing the area in question with the seeds of the crop which he hopes to reap. If the crop is a good one, the farmer rejoices; if he gets but a trifling return for his season's labor, he grumbles at his luck, or wants the Government to order a bounty, or to pass a prohibitory tariff. The market-gardener should know now as the result of the published investigations of vegetable physiologists at agricultural experiment stations, that some of the vegetables and fruits which bring the highest prices when marketed out of season can be brought to perfection much earlier when grown not only in sunlight by day, but under the electric light by night. Lettuce, for example, can be marketed about two weeks sooner after planting if illuminated day and night.

The horticulturist daily proves by producing various and often striking varieties of flowers or fruits the falsity of the old notions as to the fixity of living organisms. I must confess that it seems to me rather disrespectful, some persons might say rather impious, so to tamper with the natural or "divinely appointed" forms of plants, as to produce the monstrous chrysanthemums which we may see in exhibitions or in private houses. But these exaggerated and often extremely ugly because so artificial forms are the strongest evidences that the organic world, of which we are a part, is extremely plastic still in spite of its age; and that those factors which have accomplished the evolution of present complexity from primitive simplicity are still operative, and that man as well as other organisms has not yet reached his final and highest development.

I wish to say one word of that aspect of botanical science which is still but little regarded in our country, but which, if our successors are to have any forests, must receive due and practical notice. I mean the science of forestry. In Germany especially, but in other European countries also, there are forestry schools, where young men receive that scientific and many-sided training which will fit them properly to administer the private and Government wooded lands. It is an interesting fact that, great as is the expense in maintaining these schools and in managing the forests, yet the forests of Germany are one of the most profitable properties of the Government. The railroads pay a trifling interest still,

but the forests yield regular and, for Europe, high interest. We must soon acquire, by purchase or otherwise, such control of our still forested areas as will insure their preservation and intelligent use, else the boastful prophecy which I have heard more than once in Germany will come true, that Germany will be exporting wood to America within fifty years! The Forestry Division of the United States Department of Agriculture, and the small forestry associations scattered here and there in the *cities*, precisely where there can be no forests, are doing all they can to arouse public interest in the matter, and to prevent further reckless deforestizing. But to leave the trees unfelled is not all; to replant where replanting is still possible, to fell the trees that are now of useful size, to thin out that others may attain better proportions, to protect against fires, these are equally important. To do all this well demands intelligence, knowledge, and training. The training of the skilled forester must be largely botanical; for though he must know enough about zoölogy to be able to distinguish and to combat insect and other animal pests, yet he must know the principles of vegetable physiology and pathology. For these he must study under some thoroughly trained botanist.

I have attempted to sketch, I fear in very impressionistic fashion, the scope of a science whose value to man is great and personal, which is many-sided, and which is worthy of the devotion and activity of those to whom it is an absorbing interest.

ALCHEMY REDIVIVUS.

By ALEXANDER E. OUTERBRIDGE, Jr.

BASIL-VALENTINE, a famous alchemist of the middle ages, was the most noted exponent of the belief in the transmutation of metals. He thought that the germ of the precious metal gold was hidden in the base metal antimony, and claimed that by following certain mystic formulas the gold could be recovered. About the year 1445 he published in the Latin tongue a celebrated treatise entitled The Triumphal Car of Antimony, which had a great reputation, not only among his contemporaries but among his successors. The treatise was couched in cabalistic phraseology—a sort of abracadabra—which, of course, the vulgar people could not comprehend; it was designed only for his disciples. The book purports to contain the "twelve keys of the great stone of the ancient philosophers."

His formula for converting antimony into gold is interesting at the present time, in view of the fact that a modern alchemist has actually succeeded in inducing the Secretary of the Treasury

to officially order an investigation, by three of the mint experts, of a process of transmutation, or "creation," of gold which is singularly similar to the old alchemists' plan.

Basil-Valentine concealed his secret from the common people in the following mystic words: "The king's diadem is made of pure gold, and a chaste bride must be married unto him, wherefore, if ye will work on our bodies take the most ravenous gray wolf, which, by reason of his name, is subject to valorous Mars, but by the genesis of his nativity he is subject to old Saturn; found in mountains and in valleys of the world; he is very hungry; cast into him the king's body that he may be nourished by it; when he hath devoured the king make a great fire, into which cast the wolf that he be quite burned, then will the king be at liberty. When ye have done this thrice, then hath the king overcome the wolf, neither can he find any more of him to feed upon."

The mysterious language adopted by the alchemists was not always owing to an intention to deceive; many of these fanatics believed that it was wicked to reveal the hidden secrets of Nature to the common people, and might even cause the death of the author. Thus, Wilhelm von Schroeder, in 1684, wrote a book entitled Necessary Instructions in the Art of Gold Making, in which he says: "When philosophers speak openly, a deceit lies behind their words; while when they speak enigmatically, they may be depended upon."

Reverting to the enigmatical formula of Basil-Valentine, it is said that the key to this mysterious jargon gives the following simple explanation: The ravenous gray wolf is the sulphuret of antimony. The king's body typifies the metal gold. The sulphuret of antimony is decomposed by iron by the aid of heat, and is thus "subject to valorous Mars." When these elements (antimony, sulphur, and iron) are subjected to a great fire in a crucible, the king (gold) imprisoned in the wolf (antimony) is liberated.*

The modern process which the three mint experts were called upon to investigate, and upon which they have reported negatively, was at first shrouded in secrecy; but the inventor himself has recently given to the public his formula, in a newspaper interview, which one of the experts stated at a meeting of the Franklin Institute is substantially correct. His process consists

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* In 1423 Henry VI of England issued a royal proclamation encouraging the art of gold making, and in 1476 Edward IV accorded to a company "a four years' privilege of making gold from quicksilver." The Danish ducats of 1647 were made of gold obtained, as it was believed, from artificial sources, by Caspar Harbach, the alchemist of Christian IV. In 1648 a large medal was struck for Emperor Ferdinand II from "artificially prepared gold," and the ducats struck under Landgrave Ernest Lewis, of Hesse-Darmstadt, were supposed to be of artificial gold prepared by the transmutation of lead. In 1700 an alchemical work appeared bearing the appropriate title Chymical Moonshine.

essentially in subjecting antimony, sulphur, and iron to intense heat in a crucible, whereby a portion of the antimony is supposed to be changed or transmuted into gold, and this is subsequently recovered by the usual metallurgical methods.

The experts found, on repeating these experiments, using the purest antimony that could be obtained from chemists, that a tiny globule of gold and silver remained after removing all the iron, antimony, and sulphur; but they also found that traces of gold and silver are invariably associated with native antimony, and when they succeeded in producing chemically pure antimony for the test, not a trace of gold or of silver resulted from the subsequent transmuting or "creative" process.

Some criticism has been expressed that the United States Government should have dignified this ridiculous claim, to the extent of ordering an investigation of it by the mint metallurgists, but their report is well calculated to set at rest the preposterous scheme which had already attracted not a few gullible people, including some investors.*

This investigation recalls a series of interesting experiments which were made in the Philadelphia Mint about forty years ago by the former assayer, the late Jacob R. Eckfeldt, the results of which were communicated to the American Philosophical Society by his assistant and successor, the late William E. Dubois, who also aided in the work. Samples of nearly all the known metals were obtained from various parts of the country; these were subjected to the usual processes for detecting the presence of gold, the greatest care being used to avoid errors. Gold was found in all the specimens of antimony, bismuth, lead, copper, etc., varying from one part in four hundred and forty thousand parts in a specimen of antimony to one part in six million two hundred and twenty thousand parts in a specimen of galena from Bucks County, Pennsylvania: this was equivalent to two grains and a quarter, not quite ten cents, to the ton.

The most remarkable result of all was obtained from specimens of clay from various localities within the limits of the city of Philadelphia; the clay was taken from a depth of about fourteen feet below the surface, and was found to contain gold in the proportion of one part in one million two hundred and

* It is stated that the inventor of the so-called "gold creative process" applied for a United States patent, and, upon its refusal, the matter was brought before the present Secretary of the Treasury, who ordered the investigation to be made in the metallurgical laboratory of the Mint Bureau. The committee appointed by the Director of the Mint, in accordance with these instructions, consisted of the assayer of the Mint Bureau, the superintendent of the assay office in New York, and the melter and refiner of the Mint in Philadelphia. They adhered closely to the inventor's formulas. An abstract of their report has appeared in print.

twenty-four thousand parts of thoroughly dried clay, and was very uniformly distributed.

The report says: "In order to calculate, with some accuracy, the value of this body of wealth, we cut out blocks of the clay, and found, on an average, a cubic foot, as it lies in the ground, weighs one hundred and twenty pounds as near as may be. The assay gives seven-tenths grain, say three cents' worth, to the cubic foot. Assuming the data already given, we get four thousand one hundred and eighty million cubic feet of clay under our streets and houses, in which securely lies one hundred and twenty-six million dollars. And if, as is pretty certain, the corporate limits of the city would afford eight times this bulk of clay, we have more gold than has yet been brought, according to the statistics, from California and Australia."

Other calculations show that every time a load of clay is hauled out of a cellar enough gold goes with it to pay for the carting; and if the bricks which front our houses could have brought to their surface, in the form of gold leaf, the amount of gold which they contain, we should have a glittering show of two square inches on each brick. A single specimen of zinc proved to be absolutely free from gold.

These investigations proved that, while gold is justly considered one of the rarest metals, it is also one of the most widely diffused, and there are many philosophical reasons to be found in explanation of this apparent paradox.

THE FORCES IN AN AIR BUBBLE.

By M. G. VAN DER MENSBRUGGHE.*

IN 1880 I had the honor of lecturing before the Class of Science on the metamorphoses undergone by a drop of water, when I described the several phases of the grand cycle which the drop passes through from the moment it forms part of the great ocean mass till the time when after long journeys and numerous transformations it again joins its companions in the sea. A few months ago I in a similar way told the history of a grain of dust, dwelling especially on the universality and abundance of solid particles in the atmosphere, pervading everywhere on the surface of the earth.

I now proceed to describe the career of another minute body hundreds of times lighter than a drop of water or a solid corpuscle, confining myself to the consideration of its relations with

* Address before a public meeting of the Belgian Academy of Sciences, December 14, 1895.

liquids and solids, and we shall find that it in no wise falls behind its rivals in activity and prowess. This marvelous little being is a simple particle of air.

Although this particle and its companions wholly escape our vision, they are diffused everywhere around us, and even penetrate our organism to such an extent that without a multitude of them playing a definite part within our body we could not breathe or live for an instant. We can not isolate these particles of air, and could not see them if we did, but we can isolate masses of them by various methods and distinguish them very clearly. Thus let us take a watch glass and a capsule of water, and turning the concavity of the watch glass down, incline it slightly and plunge it into the liquid. Immediately we see a bright line that appears to define the limit of the moistened part of the concave surface of the watch glass. The rest of this face of the glass is kept from being wetted like the whole of the convex surface by the intervention of a mass of particles of air, which, somewhat compressed during the immersion, group themselves into a gaseous globule. Before it was isolated by our maneuver the globule had constituted part of one of the thousands of concentric layers of our atmosphere, each of which weighing upon the one beneath it and communicating to it besides the weight of the layers above it, they all together determine a total even pressure at the level of the sea of fifteen pounds to the square inch. Our globule of air is likewise subject to this pressure, which is transmitted through the water, and added to it is the weight of the liquid that lies above it.

This globule really betrays its presence only by the bright liquid layer around it. When we inquire for the force by which the regular shape of the globule is controlled, we find it, according to the researches of Plateau, in a thin liquid portion surrounding the volume of air, which is not more than one twenty thousandth of a millimetre thick, and which is endowed with a contractile force always impelling it to occupy the least possible space on the body it covers; and by virtue of its curvature it exercises upon the air imprisoned by the liquid a pressure greater in proportion as the globule is smaller. If these dimensions are extremely small, the gaseous globules are always spherical—as, for instance, the bubbles of carbonic acid that rise through a frothy liquor.

Our globule of air imprisoned in the watch glass, acted upon by the pressure of the atmosphere and by that of the liquid above it, and further by the capillary pressure of the bright film encompassing it, possesses, to resist these three pressures, an elastic or repulsive force which is more marked as it is more closely compressed, and by virtue of which the globule occupies a larger

space the instant the external pressure is removed or diminished. Perfect quiet seems to rule in the film enveloping our particles, but this calm is only relative; and if we supposed the ultimate particles immensely magnified, we should find the conditions very stormy indeed. We have already mentioned the elastic force within the globule which gives it a tendency to expand. The liquid enveloping it is also subject to a law which is illustrated when wet objects dry, and when a cup of water placed on the scale of a balance is found to be losing weight from day to day. The superficial particles of water have a constant tendency to separate from the rest of the mass and go off as invisible particles of vapor so light that they rise in the ambient atmosphere. This passage from the liquid to the vaporous condition goes on gradually, so that the distance between the molecules becomes greater the nearer we approach the free surface. While this takes place in the radial direction, the movement gives rise in the tangential direction to contractile forces that act to give the liquid surface the smallest possible extent.

We may now suppose ourselves witnessing a struggle between rival particles, some of which are continually trying to escape into the globule of air, while others—our gaseous particles—are all the time striving to penetrate into the water. The spherules escaping into the air have at the same time an extremely pronounced tendency to resolve themselves into molecules incomparably more tenuous still, and to produce vapor even lighter than the air. As water is a medium of perfect mobility, each detached spherule gives rise to vibratory movements, and these are communicated to the whole liquid mass. If we turn our attention to the particles of air, we find them making incessant efforts to lodge themselves in the open parts of the line of battle. As soon as one of them has penetrated between two liquid molecules in vibration, these, obedient to their mutual attraction, make it advance still further; and so on till it reaches the midst of the mass. Thus many particles of air one after another penetrate to the deepest parts of the water, where they are strongly compressed and acquire greater cohesion, while the mean cohesion of the water continues to diminish; and as the particles of vapor passing into the air finally saturate it, so no more particles of air can go into the water after it is saturated with gas.

It follows that the lower the temperature, and, consequently, the stronger the cohesion of the water, the more considerable may be the quantity of dissolved air; and for this reason, doubtless, the slightest variation of temperature modifies the power of water to absorb air. We can also easily comprehend that the quantity of air dissolved in water increases as the external pressure becomes greater. Numerous applications are made of this property—

in the manufacture of carbonic-acid waters, for instance. The air thus incorporated in the water is easily removed by warming the liquid, when infinite numbers of little bubbles may be seen adhering to the walls of the vessel or rising through the midst of the water. But to drive out all the dissolved air, the water should be subjected to a prolonged boiling, and this causes a wonderful increase in its cohesion after it is cooled; and water which has been treated thus will not boil except at temperatures considerably higher than the normal boiling point. Every engineer knows that the water from which he generates steam in his boilers must be aërated, if he would have the machine work regularly and avoid the danger of explosion.

Seeing so much effort displayed without relaxation on the confines of the water and the air in a simple gaseous globule, it is natural to inquire into the enormous sum of work that must be effected without interruption in the surface common to the whole atmosphere and all the rivers, streams, lakes, and seas of the globe; but the most brilliant imagination is confounded in the face of so prodigious an activity.

Who, indeed, shall measure the immense quantity of invisible vapor diffused in the atmosphere? In what balance shall we calculate the weight of the fogs and the clouds suspended above our heads? Who shall weigh the long streams of ice particles floating in the upper regions of the air? Who, in particular, shall adequately estimate the services that are rendered to mankind by those legions of liquid particles that are carried up to great heights in the atmosphere, and distribute warmth and fertility everywhere?

To return to our particles of air penetrating the free surface of the water, what should we see if we fancied everything sufficiently magnified? Gaseous particles gliding one behind another in the intervals of the upper liquid layer; here, particles of the pre-eminently vivifying gas, oxygen, whose mission it is to purify the water and give breath to the inhabitants of rivers and seas; there, molecules of another gas, the mission of which, among other things, is to modify the intensity of the action of its companion; argon, the office of which we hope to find out some day; and molecules of a fourth gas, carbonic acid, which is essential to the growth of plants. But this is not all, for we are further astonished to see penetrate the water infinite numbers of animal and vegetable germs only awaiting favorable conditions to grow and develop with wonderful rapidity. We all know that if water previously boiled be exposed to the light in an open vessel there will form on the sides of the vessel in the course of a week spots in which a powerful microscope will reveal the presence of millions of minute plants associated with legions of animalcules.

The results of numerous and delicate observations show also that germs of plants and animals exist as universally in the air as in water; and when favorable conditions of light and temperature come, these germs at once grow, multiply, and become visible under the microscope.

Approaching the relations of our air particles with solids, we meet the question of what these minute bodies can have in common with compact masses of invariable form, incomparably denser than they, and all the particles of which seem to be too dense to permit the access of our gaseous particles. This, the hitherto prevalent idea of the structure of solid bodies, does not conform to the real condition; for, just as the superficial parts of liquids tend to diffusion in the ambient air, a like habit exists in the molecules of solids of being repelled from the interior toward the exterior, and they separate from one another, but only in an extremely thin exterior layer. Thus camphor, iodine, ice, and some other substances change into vapor at ordinary temperatures; and the exhalation of perfumes may be something of the sort.

Many other facts point to an exceptional constitution of the free surface of solid bodies, of which I need cite only the experiments of M. De Marçay on the vaporization of metals in vacuum at temperatures below their melting points, and especially the researches of M. Spring on the direct uniting of metals, either of the same or of different species. We conclude from all these evidences that there exists on the surface of solid bodies an extremely thin layer, the density of which diminishes the more nearly we approach the free surface. Let us assume, consequently, such a special constitution for the superficial layer of solids, and, by a new effort of our imagination, witness the unrelaxing work of our particles of air in the immediate vicinity of some solid body; we might thus see them dashing into the invisible intervals between the extreme molecules of the solid and opening passages for themselves through innumerable spaces, whence there results a whole formed of solid particles and more or less condensed aggregations of certain gases. Possibly this is the way in which has been developed that texture, doubtless very fine but still very resisting, which covers all solid bodies and is also very difficult to take away from them.

You ask, Of what interest to us is this incessant activity of the air? We answer that it has an interest of the very highest importance; for without this protecting layer covering solids, every object brought in contact with another would risk adhering to it so closely that they could not be separated without a great effort. It is this invisible layer that permits the workman to use his tools handily, the reader to turn the leaves of his book

with ease, the writer to guide his pen at will, and the pedestrian to raise his feet from the ground; in fact, I should never get to an end if I should have to recall the principal examples of the utility of this microscopic cushion of air on the surface of solid bodies.

Long and patient observations by Moser and Waidele have made it extremely probable that every substance has its special gaseous envelope, which depends on the condition of the free surface, the temperature, the pressure, the vapors diffused in the surrounding space, etc. This is so true that it is enough to pass the finger over a plate of glass or metal to modify the minute molecular aggregate covering the surface. We can prove this by tracing, with the finger or any kind of rod or stick, invisible characters on the plate and breathing upon it, when all the tracings will immediately come out on it; for this reason, beyond a doubt, that the vapor of the breath deposits itself in different manners on the surface that has not been touched and on the parts followed by the tracings. Further, if we allow two metallic plates to remain for a considerable time slightly removed from one another, one of which is highly polished, and the other bears engraved characters such as may be found on a presentation watch, on separating them, say after two months, simply breathing on the surface of the smooth plate will cause the characters engraved upon the other to appear revealed. The cause of this appearance is, that the hollowed parts of one of the plates condense more air and moisture, and thus, by frequent changes of temperature and pressure, the parts of the smooth surface opposite the cavities are covered with a gaseous envelope different from that of the parts adjoining, and the difference is marked by a special condensation of the vapor of the breath.

Legions of grains of dust are known to be floating in the atmosphere, not near the ground alone, but miles above the sea level. We may form an estimate of the prodigious number of these solid particles suspended in the air by collecting snow during the earlier moments of a fall; the water resulting from the melting of it is nearly black with the corpuscles of every kind which the little ice crystals have brought down in the cavities of the snow. Later collections of snowflakes give clearer and clearer water. The snow has therefore been called the "broom of the atmosphere." The particles can not be held up in the atmosphere of themselves; for, taken one at a time and thoroughly dried, they will certainly weigh more than the air they displace. To learn the real cause of the phenomenon, we must recollect that the constitution of a solid particle is that of a minute kernel surrounded by a very thin layer of gradually decreasing density, into which the surrounding air infiltrates itself so as to make a

kind of sponge; hence, the smaller the kernel the more notable the influence of the lighter sponge. Another perhaps more important cause may be found in the power of the cavities of a grain of dust to attract moisture from the air, by virtue of which an atmosphere of invisible vapor is gathered around the corpuscle so as to form a single system with it. The density of vapor being only about two thirds that of air at the same pressure, this vaporous envelope has great sustaining power, and its presence furnishes an adequate explanation of the suspension of so much solid matter.

Although the presence of these millions of particles may diminish the transparency of the atmosphere, they contribute to the illuminating power of the sun by reflecting its rays in every direction and causing all the space to be pervaded with light, and, intercepting the rays of heat as they pass from the earth, they prevent loss by too rapid radiation. A similar explanation accounts for the suspension of globules of water in clouds.

We come now to the powers of our particle of air to emit sounds, which are always curious and often imposing: manifested in the snap of the coachman's whiplash, when the particles suddenly thrown out of equilibrium execute sonorous vibrations in recovering it; in the resonance of artillery discharges, the roaring of the tempest, the moaning of the surf, and the rolling of the thunder—all reactions of air against forces which have compressed it.

When we bear in mind the power displayed by particles of air hurled in violent wind against a fixed obstacle, we are led to ask how these particles exhibit their energy when the air is traversed by a projectile—spherical it may be—moving with great velocity? Since the air, in spite of its extreme mobility, opposes a degree of resistance to any sudden displacement, the vacuum created behind the projectile is not instantly filled; and not all the particles in front of it being able to get out of the way as fast as it goes along, an accumulation takes place there which exerts considerable pressure against it. The situation then becomes the same as if there was a spring in front of the ball strong enough to nullify every instant a part of its velocity and to deform a solid obstacle placed in its course. Melsen was struck by this thought, and instituted a series of experiments that gained him great credit, the result of which was to prove that the air accumulated in front of a ball flying with sufficient velocity forms a gaseous layer capable of opposing the immediate contact of the projectile with a resisting medium, particularly at the point squarely opposed to the course of the missile. This view was very clearly confirmed by Prof. E. Mach, of the University of Prague, who obtained a photographic image of a projectile moving with great velocity and

preceded by condensed gaseous waves. We can not, therefore, doubt that the cushion of greatly compressed air in front of the projectile causes considerable delay in its progress, and consequently a great heating of the ball. We know that this takes place with aëroliths which become incandescent and burst in flying through our atmosphere.

Melsen's experiments led me to suppose (in 1874) that the obstruction and heating of a projectile passing through the air might be notably diminished by driving a narrow and slightly conical channel through the ball and slipping into it a metallic obturator to fit it. "In this way," I said, in my lectures on thermodynamics, "the ball might be discharged without letting more gas escape than usual; once out of the chamber, it would condense the air in front of it, while the air behind it would be extremely rarefied. A difference of pressure would immediately be produced sufficient to force the conical tampon out of the projectile, and after that there would be no more projectile-air pressure." Under these conditions, I said, the velocity of projectiles could be kept up for much greater distances, and the heating would be considerably less. I was not so situated that I could verify these views by experiment; but the principle was applied about two years ago in Germany, in the Hebler Kruka ball, the axis of which is pierced with a small cylindrical channel, enlarged behind so as to be funnel-shaped, and closed with a small plug—the very device I had imagined twenty years before—which, when fired from a cannon, behaved just as I supposed my perforated ball would do.—*Translated for the Popular Science Monthly from Ciel et Terre.*

THE DISCOVERY OF THE SUN SPOTS.

By M. A. LANCASTER.

SPOTS or groups of spots were seen more or less distinctly upon the sun previous to the invention of the telescope. The observations are described under various forms, first among which may be mentioned obfuscations or obscurations of the sun. At other times they were believed to be passages of Mercury in front of the sun, as in 807, a date mentioned by the historians of Charlemagne, and on the 28th of May, 1607, when even Kepler was deceived. In 859 Alkindi thought he observed a transit of Venus; but the black object he saw on the sun's disk was only a spot large enough to be perceived by the naked eye.

Observations of obscurities or spots on the sun have been made in China at different epochs, the most ancient one dating from the year 301. Between that date and the beginning of the

thirteenth century the great Encyclopædia of Matouan-lin contains forty-five mentions of the phenomenon. The existence of dark spots on the sun was recognized very anciently by the aborigines of Peru. The Arabs have recorded prolonged observations of the disk of the sun, among which are those of 535 and 626.

The oldest mention of a sun spot in Europe, a spot which was supposed to be Mercury, is by an anonymous chronicler of the eighth century. Different observations of sun spots before the invention of the telescope are recorded in Zach's *Monatliche Correspondenz*, vol. xv, 1807, and in Humboldt's Cosmos, vol. iii.

The new instrument, invented in Holland, first permitted the scientific study of the solar surface. Galileo appears to have seen the spots on the sun for the first time in October, 1610, but did not account for the nature of the phenomenon. Jean Fabricius may have remarked the spots toward the end of the year 1610, and certainly observed them in March, 1611. Scheiner reported his discovery of the spots in April, 1611, but did not account for what he saw. Harriott, who is believed by Zach to have seen the spots as early as December, 1610, and whose manuscripts have been examined by Rigaud, did not really see them till early in December, 1611, and comes, consequently, only fourth in the order of priority.*

There have been lively controversies at different times concerning the claims of these three astronomers to priority in the discovery of the sun spots. The discussions were summarized by Arago in an article published in *l'Annuaire du Bureau des Longitudes* in 1842. The question has been settled by deciding that Galileo first saw the spots with the aid of the telescope, but that Fabricius first announced their existence to the scientific world and pointed out their nature. The texts were plain enough on this point, and the discussion was prolonged more by the agitation of questions concerning the meaning of words than by any need of clearing up the facts.

A work recently published by Dr. Gerhard Berthold on Fabricius† contains a number of previously unpublished documents, and throws light on some obscure points in the history of astronomy at the beginning of the seventeenth century.

An interesting analysis of this essay has been published by M. E. Millosevich in the *Atti* of the Accademia dei Lincei of Rome. While its main object is to establish the claim of Jean Fabricius to priority in the discovery of the sun spots, it further furnishes many facts previously unknown in the life of this astronomer and

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* These facts and dates are from Houzeau's Vade-mecum of Astronomy.

† Der Magister Johann Fabricius und die Sonnenflecken.

of his father, David Fabricius. The claim of priority having been already settled by Humboldt, the secondary object is really the more important one. A little-known paper of Jean Fabricius on sun spots and their apparent turning with the sun, published at Wittenberg in 1611, is reproduced in the book; and after it a wholly unknown astrological paper by David Fabricius on the appearance of the new star in Ophiucus, which Kepler's pupil, Jean Brunowski, discovered on the 10th of December, 1604. David Fabricius saw this star for the first time December 13, 1604, or only three days after Brunowski, of whose discovery he certainly knew nothing, and wrote two other notices of it, which are lost. The frontispiece of David Fabricius's *Prognosticon astronomicum* is also given, with a complete list of the author's writings, including those which are lost. Of these, the *Prognostica* for 1607 and 1616 have recently been found at Darmstadt and Nuremberg. From a few facts concerning the life of David Fabricius gleaned from the *Prognosticon* for 1617, it appears that he was born at Essen, in East Friesland, March 9, 1564, and died—killed with a spade by a peasant of his commune—May 7, 1617. He assumed the ecclesiastical dress at an early age, and performed the offices of a court pastor, while he also devoted himself to astronomical studies, and was the first to announce that Omicron or Mira Ceti, was a variable star.* He made this discovery August 13, 1596, and on the same day remarked a star of the third magnitude, red like Mars, and situated in 25° 47′ and 15° 45′ south of the ecliptic. Twelve years passed without his seeing it only very indistinctly, and he did not find it again clearly till 1609. The author observes that the astrological intimations of David Fabricius did not prevent his being a good astronomer of the second rank, like Longomontanus, Scheiner, and Simon Marius. His correspondence with Kepler proves that he furnished him with important material for the composition of his works.

Jean Fabricius, the eldest of seven sons, was born at Resterhave, near Dornum, in East Friesland, January 18, 1587. The *Calendarium historicum* of David Fabricius gives some facts concerning his life. He attended the university at Helmstadt as a medical student in 1605, at Wittenberg in the next year, whence he passed to Leyden, where he was registered as a student of medicine in 1609. Omitting certain statements concerning his astrological and meteorological studies, we remark that the publication of the work to which he owes his fame in astronomy dates from the time of his doctorate in philosophy at Wittenberg,

* The period of the variability of this star was determined by Jean Holward, forty-two years afterward.

whither he returned after his sojourn at Leyden. The telescope was discovered in Holland in 1608 by the optician Jean Lippersheim, of Middelbourg, who immediately applied to the States General for a patent. Jean Fabricius learned of the discovery at Leyden, and took the instrument to Osteel, where his father was, and with it found the sun spots. Nothing is known of him after the publication of the book on the sun spots already mentioned (1611), except that he practiced medicine at Marienhave, near Osteel, and died there probably about 1617. If the *Prognosticon* for 1618 had not been lost, we should doubtless have had some details respecting his death. In the lack of other sources of knowledge, there is left us the eulogy addressed by Kepler to David Fabricius: "But also reading in your *Prognosticon* for the year 1618, by which I am better informed concerning his [Jean's] too early death," etc.; and further on, "But, indeed, there is this excellent little book concerning the solar spots in the year 1611," etc. The author gives particulars concerning the first day of the discovery, the method of observation by projection, and the conclusions which Jean, aided by his father's advice, drew (*spots fixed in the body of the sun*) concerning the sun's rotation around an axis. Neither the Narration nor the writings of David, so far as they are known to us, give any hints concerning the exact date of the discovery, so that we were confined to guesses till M. Berthold found the *Prognosticon* of David for 1615, which gave the 27th of February (9th of March N. S.), 1611, as the exact date of the event. Furthermore, a letter from David to Maestlin says that the Narration appeared at the time of the autumn fair of 1611, and this is confirmed by Kepler.

At this point in his learned essay Dr. Berthold discusses the question of priority, for which a claim was earnestly pressed as against Galileo by the Jesuit Scheiner, who assumed the name of Apelles. It is really very singular, as it appears to the author, that not a word was said of Jean Fabricius in this controversy, and it might be inferred that both contestants alike knew nothing of the Narration, but for certain considerations and facts adduced by Dr. Berthold which make this supposition exceedingly improbable, if not impossible.

It is proper to observe here that after the telescope was invented all the discoveries in celestial objects became, as it were, matters of course, and that, whatever noise might be made about them at first, the merit of the observers is insignificant in comparison with that of the calculators who knew how to reason out the basis of the true system. Even if it should be proved that Galileo learned of the existence of the spots from Fabricius's Narration, or from the letters of the false Apelles, the remarkable fact remains that in his first reply to Welser he corrects the

errors in the reasoning of Apelles concerning the direction of the sun's rotation.

In Mario Welser's first letter to Galileo, dated January 6, 1612, he asks Galileo's opinion concerning the spots discovered by Scheiner, and forwards three of the latter's famous letters. Three months afterward (May 4, 1612) Galileo answers him in a very long letter, saying that he has been observing the spots for eighteen months, that he has shown them to several friends, and has besides within a year exhibited them to many prelates and lords at Rome. According to this, he must have seen the spots as early as the end of November, 1610; and the discovery, or first observation, must have been as early as the summer of 1610, or before Galileo removed from Venice to Florence, the change of residence taking place at the end of August, 1610. It is proved, in fact, by a letter from the friar Fulgence Servita, a theologian of the Most Serene Republic, that he showed the spots to Father Paolo. It is not easy to divine why Galileo, usually so careful of his rights, did not this time make a claim for priority in discovery; but it may be supposed that by the side of the discovery of the Medici stars, Saturn's rings, and the phases of Venus, that of dark points on the sun, changing in character and disappearing according to the position of the star, appeared of trifling importance to him; and this is to a certain extent confirmed by the reply to Welser. Galileo's observations, in fact, did not begin to be known till in 1612; and if we did not trust to his assertions or to ocular testimony, Fabricius, Scheiner, and perhaps others, made the discovery before him; but this would not be a fair judgment. It must be admitted that Galileo first observed the spots on the sun with the aid of the Lippersheim glass; but his earliest notices on the subject did not appear till the spring of 1612, while the earliest publication on it is that of Fabricius, who discovered the spots on March 9, 1611, in complete ignorance that Galileo had observed them eight months before.

The false Apelles pretended that he had observed the spots for the first time, together with one of his pupils, in March, 1611. How, then, could Kepler have written to David Fabricius of "the sun spots seen by your son long before, Apelles," if, as we know now, Jean discovered them in March, 1611? No one was more in the current of events than Kepler, and he was astonished at the letters of Apelles. Besides, Scheiner told Welser that he had observed some darkish things on the sun, but attached no importance to them till October, when he resumed his observations—that is, after Jean Fabricius's book had been published.

It finally appears from Dr. Berthold's book that (1) Galileo was the first to observe the spots on the sun with the Lippersheim telescope in the summer of 1610, but he did not publish his draw-

ings and observations till the spring of 1612. At that time he was master enough of the question of the sun's rotation to correct Scheiner's errors. (2) Jean Fabricius discovered the sun spots on March 9, 1611; he was acquainted with the sun's rotation, and was the first to publish a work on the subject. His discovery is quite independent of any previous suggestion. (3) Scheiner may also have observed the sun spots independently in March, 1611, but he attached no importance to them till October of the same year, after the publication of the Narration by Fabricius. His merit consists in his having continued the observations, and in having collected a large number of them, which were inserted in his *Rosa Ursina*.

The "long before" (*longe ante*) of Kepler is unexplained.—*Translated for the Popular Science Monthly from Ciel et Terre.*

FOURTEENTH-CENTURY DOCTORS.

By M. E. NICAISE.

DAREMBERG says, in his *Histoire des Sciences médicales*, that the custom of consultations among doctors was extended in the thirteenth century; but it is probable that the usage existed in previous stages of civilization. There have always been grave maladies and hard diagnoses and cases involving considerable responsibilities, for which a meeting of doctors was desirable; and there have always been patients in considerable social station who liked to be taken care of by several doctors at once. Consultations, therefore, have not all the same origin or the same purpose, but the proceedings in them are always the same—examination for what is the matter with the patient, and discussion concerning it and concerning the treatment to be adopted.

On this subject, we have but few documents from antiquity and the middle ages, and of these the work of Mondeville * gives the most information. His work relates to other subjects than surgery, and might, without straining words, be styled Memoirs. Under Philippe the Fair money was scarce, and the doctor and the surgeon were but poorly paid even by the king. "I have never," Mondeville says, "found a man rich enough or honest enough, of whatever condition, religious or other, willing to pay what he had promised without being pressed or forced to do it."

* Chururgie de Maître Henri de Mondeville (Surgery, by Master Henri de Mondeville), Surgeon of Philippe le Bel of France, composed between 1306 and 1329; translated into French, with notes, an introduction, and a biography; published under the auspices of the Minister of Public Instruction, by E. Nicaise, assisted by Dr. Saint-Leger and F. Chavannes. Paris, 1893, F. Alcan.

His rancor against these patients is so great that he is ready to excuse and counsel even means which we would incontinently reject at this time, to compel them to pay acceptable fees. He does not seem to have put these measures into practice, for he had no fortune; but the fact that a king's surgeon should venture to speak as he does on so delicate a subject casts a curious light on the society of his day and its want of order; on the other hand, his remarks can not be generalized and applied wholesale to the period in which he lived.

Coming to Mondeville's exposition of the method of holding a discussion, we find his description almost a story of what might take place to-day. "First," he says, "we should inquire into the nature of the disease, examining carefully and feeling, because the diagnosis is made by touching with the hand and observing with the eye. All the consultants engage in turn in the examination. Then, if the case demands it, they make a new examination all together, pointing out to one another the symptoms of disease and the special or remarkable features either in the patient or the disease. Then one of them, the highest in rank, says to the patient, 'Sir, we perceive very clearly what is the matter with you, and you ought to have full confidence in us and be glad that there are so many of us here, and such doctors—enough for a king—and to believe that the youngest of us is competent to prescribe and carry on your treatment and bring it to a good result.' Then he interrogates the patient about the circumstances of his attack: 'Sir, do not be displeased or take it ill, but when did your illness begin?' following this with many other questions, the answers to which are recorded as indications furnished by the patient.

"When all the questions called for by the case have been asked, the consultants retire to another room, where they will be alone; for in all consultations the masters dispute with one another in order the better to discuss the truth, and sometimes they come to a pass in the heat of discussion which would cause strangers witnessing their proceeding to suppose there were discord and strife among them. This is sometimes the case.

"The oldest, the most eminent, or the most illustrious of the doctors, if there is any such among them, a king's or a Pope's doctor, should propose that they all speak in turn. If they are all silent, as they would be in the presence of so eminent a chief, he should take the floor and question them, one after another, beginning with the youngest and least famous, and so on, passing always from the inferior to the superior. If the older ones spoke first, the younger and less considerable would have nothing to add, and the consultation would thus be of no effect; while, whatever the younger doctors might say, the older ones would have oppor-

tunity, which would be valuable in some cases, to correct it, add to it, subtract, oppose, or applaud it. He should ask them concerning the character of the disease, what it is called, what the experience of experts has been with it, what authors mention it,* and in what part of their works. These questions being answered, he should inquire whether the disease is curable or not, and how. For a simple example in surgery," says Mondeville, "to show better how the thing is done, suppose a tumor on a fleshy part, the shoulder or the thigh, is to be treated: the doctor should inquire of what matter or humor it is formed; whether of the blood, for example. He should then inform himself concerning the disease, its beginning and progress, and ask if an evacuation is not desirable. This being decided upon, of what kind—a bleeding? If yes, in what limb or what vein, when and where; for the practice varies according to the season and the habits of the patients, and according to the aspects of the moon and the heavenly bodies and an infinite variety of things." Such is the regular, decorous consultation, but things did not always go on thus smoothly.

Before repeating what Mondeville says concerning the incidents of consultations, I will expound the sage precepts he lays down for consultation at a distance, a subject to which he devoted a whole *notable*. This is an important point when we recollect that at that time, and thence on down to the sixteenth century, the doctor often gave his advice without leaving his office, without seeing the patient, by examining his fluids and asking some questions of the messenger.† It is not worth while to give all that Mondeville says, but only the principal parts of his chapter, omitting the arguments which he draws from the authors that preceded him. It was one of the characteristics of the period, as I have already remarked, that authors generally rested their opinions, not principally on their own experience and studies, but on what Galen and some Arabian authors said. The respect of some for their predecessors was absolute, and they cared for nothing besides what rested on the authority of these.

* This was characteristic of the age. Even doctors well instructed and advanced in experience did not venture to rest on their personal opinion, but had always to invoke a predecessor, Galen or the Arabs, as the original authority. Mondeville, however, paid less attention to this custom than some of the others.

† Already at that time famous doctors and surgeons went to see their patients, notwithstanding the difficulties of communication; Lanfrance, Mondeville, and Guy de Chauliac give us proof of this fact. There were other doctors, clerks, and canons, as were most of the *maîtres régents* of the Faculty of Paris, whose dignity forbade their visiting patients and who gave consultations by interrogating the messenger and analyzing the urine of the patient. This custom disappeared after the reform introduced in 1452 by Cardinal d'Estouteville, who obliged the new doctors regents who received no prebends from the Church, to busy themselves with their patients. The contest of the faculty and the surgeons originated at that time.

Mondeville rose bravely above this principle, but yielded sometimes to its influence, and also called the Arabians to his aid.

On the subject of consultation at a distance, he observes that "people have often asked counsel of us surgeons on the treatment of diseases that we have not seen and can not see, because of the absence and distance of patients who can not be brought to us, while we can no more go to them. Under such conditions, it is neither safe nor conformable to the precepts of the art and of a good conscience to make out a prescription of curative treatment for diseases hard to cure, like cancers, fistulas, etc. It is, however, permissible, after having legitimately excused one's self, to prescribe a palliative treatment. In diseases easy to cure, in recent small wounds—for example, boils, tumors, slight contusions, etc.—we may give a curative prescription to absent persons. We should laugh indeed at surgeons," he adds, "if the patient had to appear personally before them for a light disease as well as for a serious one.

"Possibly the messengers from persons seriously ill will tell us that they know as well as the patient himself all the details of the disease; but this is not possible, for no one can extract facts as appropriate and useful in the particular case as the doctor. The patient would not pay due heed to the questions if they did not come from the doctor; and even if the messengers did exactly describe the condition of the patient as it was—and even this is not possible—they would be wholly, or to a large extent, ignorant of his present state, for it would have changed in the interim." In the proceedings just described things were done correctly, as in our own time, but it was not always so; and there are some statements in Mondeville that throw a curious light on the manners of the fourteenth century.

He represents many persons as choosing their doctor without troubling themselves to know whether he was well taught and experienced; others were not satisfied till they had as many doctors around them as possible. "There are frequently," he says, "Parisians who, when ill, call together a great many doctors of different sects, to consult with them. Some think that the more surgeons they have, the sooner their disease will be cured—the same, for example, as ten masons working together on a wall will accomplish as much in one day as one mason can in ten days. Patients who know how to distinguish among surgeons the one who has the best training and experience prefer to have only one"—and that is Mondeville's advice.

But if complications arise, as a fourth day of fever,* it will be

* "Most usually," says Mondeville, "the fever accompanying wounds is ephemeral; but sometimes it changes into a fever of suppuration, and this is to be feared when the

preferable to call two surgeons, "and if possible, let them be friends, of the same sect, and agreeing in opinion; if two such can not be found, then a third should be taken in, in order solely to make the others agree after they have discussed the matter." Mondeville is not a partisan of a large number of consultants. He found many inconveniences and few advantages for the patient at the numerous meetings which he attended as king's surgeon. He then makes an irreverent comparison, of the patient to a dog and the surgeons to its hair: "We are," he says, "like the hairs of a dog: the longer and coarser they are, the more they annoy the animal, because they overload him and furnish a harbor for lice, and are of no use in any way, for dogs seldom die of cold. . . . The more numerous we are," he adds, "the less each one of us feels himself responsible. Each says that no larger part of the treatment fell upon him than upon the others. Hence, the more doctors the sick man has the more he finds that he has few or none. If affairs go ill, every doctor excuses himself, and holds that he is absolved. In this way it often happens that wealthy patients are less effectively treated than poor ones, because of the number of doctors they have around them. On the other hand, a large number of consultants embarrasses the attending doctor, and prevents his following his habitual practice; while, if he does not pay strict attention to the observations of the others, they regard him as a disagreeable, proud, self-conceited man."

The experienced surgeon, when he is alone, uses processes which he is not willing to reveal to the others (every one keeps his secrets, and every one pretended to have them in those days), or he is afraid that they will reject his remedy, as some do, who will nevertheless make a note of it to use it on occasion. Or, again, if his remedy is accepted, each of them will want to add something to it—one rose, another melilot, a third camomile—whereby the medicine will lose its virtue and the surgeon will not accomplish his purpose, and will be exposed to reproach from the very persons who have nullified his remedy. And, lastly, when the surgeon reveals to others, who knew nothing about them, the conclusions to which his experience has led him, they will say, "That is what I observed a long time ago," or "That is what I was just going to say."

Another argument adduced by Mondeville against a large number of doctors is that an experienced doctor is really seldom mistaken, while it is impossible, when several doctors have come together, for them all to be agreed as to the cause of the disease, its nature, symptoms, and treatment, for there will be as many

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fever is prolonged beyond four days." This is why our author makes the limit of four days intervene before determining it to be necessary to call in another surgeon.

opinions as there are heads. If by chance they should agree upon the purpose to be effected, they will differ concerning the details. One will propose, for example, in the treatment of a tumor, to make it ripen, while another, who had intended to prescribe the same, will say althea and a third ursine, and so on with the others, if there are a thousand of them; then all these drugs will be mixed in the same medicine, although mallows alone would have been the best.

An anecdote is related by Mondeville in illustration of the desire that prevailed in those days to appear to be doing something. During a consultation, when a number of the best doctors in Paris had just formulated a prescription for a sirup, a belated colleague came in. After carefully examining the prescription, he added a berry. On the others expressing surprise, he exclaimed: "Mutton-heads and oxen! why are you looking at me so? How could I conscientiously take my part of the fees if I did not put something in the sirup?"

If the consultants do not dispute over some definite object, they will dispute from jealousy or hatred; and the instant one of them suggests something reasonable and conformable to experience, the others, even though it was what each one of them himself would have recommended if he had been alone, rise one after the other and agree in declaring the contrary of what was proposed.

Mondeville thus describes consultations under two different aspects. The first picture presents the typical, orderly consultation; the second exhibits the daily strifes and rivalries, of which he collects several various types in a few lines. Viewed in this light, the men of the fourteenth century were much like those who followed them, except that they were more brutal and less careful of delicate forms.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE progress of Tommy Stringer at the Massachusetts Kindergarten for the Blind affords a remarkable illustration of the power of suitable training to awaken and develop a mind from the darkest obscurity, and when the conditions around seemingly act only to eclipse it Tommy was brought to the institution, four and a half years old, in 1891, blind, deaf, speechless, with no great intelligence, and "not unlike a puppy in some of his instincts and characteristics." He was placed under the charge of a special teacher—and a competent one—who devoted all her time to him. He is described in the last published report of the institution as having become "a fine boy—bright, energetic, manly, instinct with life, erect in stature, innocent as a lamb, frolicsome as a kitten, full of fun and ingenuity, and not destitute even of a tendency to mischief"; pure, honest, intelligent, generous, using tools handily and with good taste, and advancing well in all the branches of education, mental and physical.

SKETCH OF SAMUEL LOCKWOOD.

By W. S. SNYDER.

IN Freehold, N. J., and almost upon the historic ground of the battle of Monmouth Courthouse, in an inviting home built to his liking, lived until January 9, 1894, the Rev. Samuel Lockwood, Ph. D., widely known as a general naturalist, and a shrewd observer and describer of the habits of animals. Such was his retiring and unpretentious nature that the writer had great difficulty in securing his consent to the publication of the story of his life. But long acquaintance and occasional meetings at last thawed the reticence, and I am now, after his death, permitted to give a brief account of it.

Prof. Lockwood was born in Mansfield, England, January 20, 1819. His father, William Lockwood, was a man of devout piety, a leader among the Wesleyan Methodists, and, as a citizen, well versed in public affairs. His mother, who was taken from him at an early age, and for whom he entertained a loving regard, was the daughter of a Moravian exile from Prussia, who became head master of an English endowed school, and was known for his superior artistic tastes and for his engravings on copper. On her death the household in England was broken up, and the father with his little boy started for New York city, where the boy was brought up and received his education. I am unable to give his exact age at the time, but in very tender years the future naturalist began to unfold. A huckleberry party, going into the country one day, were caught in a drenching thundershower. Returning in haste to their stopping place, the boy Samuel left the others, and, making a short cut, went by a bypath through a low meadow. Suddenly he paused. Finding a snake lying in the path, and supposing the reptile was dead, he picked it up and carried it home, reaching the house in advance of the others. Before the rest of the party came in, a little boy in the house was taken into the confidence of the young naturalist, who, with the reptile on his lap and a pin in one hand, discoursed to him about the beauty of the scales upon his snake, pointing to their outlines with the pin. So absorbed was the juvenile lecturer in his theme that he was unaware that the entire company had become his auditors.

Young Lockwood's education, with the exception of the bare rudiments, had to be provided by the labor of his hands and brain. He worked his way into the University of the City of New York, where he attracted the attention of the eminent classicist, Dr. Lewis, and of the elder Draper, eminent in physics. With Dr. Henry, the rhetorician, his relation was different. Lock-

wood had somewhat independent notions concerning the rhetorical proprieties, and, holding college compositions in no high esteem, failed in a corresponding degree to be appreciated by the professor. Yet he was all the time paying his way through college with his pen, being employed as an assistant editor on the New York Sun, then under the control of Moses Y. Beach. Very much surprised was the professor when he learned from one of Lockwood's classmates that he, the member of the class who stood lowest in marks, was thus practically achieving a substantial literary success.

In consequence of an attack of brain fever, Lockwood left college during his sophomore year and retired to the country to recruit. A classmate came to visit him, and during his stay the two youths went for a hunt. They bagged some birds and squirrels, which were carried to the farmhouse where they were staying. The good wife prepared the game for dinner in delicate style, but while the classmate ate with evident relish, Lockwood, although declaring that he was "as hungry as a bear," found his conscience smiting him, and the savory dish seemed only to accuse him of a wicked and selfish slaughter.

Prolonging his stay in the country through the vacation season, Lockwood one day discovered an oriole's nest at the extremity of a provokingly high and long branch of an oak. To get at the nest without destroying the limb was impossible. At the farmhouse he expressed a wish to get the young birds, when an inmate said, in a taunting way:

"I'd like to see a city chap get them birds!"

That was a challenge. He undertook the capture, and by a series of ingenious devices, combined with steady persistence, secured the whole brood.

This incident rooted more deeply than ever the taste of the student for natural history. When his graduation was near, Dr. Draper, the chemist, in whose class Lockwood stood very high, endeavored to impress upon him that it was his duty to enter the medical college. The young man's trend was, however, toward the Christian ministry. This inclination, which became an irresistible desire, was encouraged by the Rev. Dr. Ferris, afterward Chancellor of the University, and Colonel Crosby, father of the late Rev. Dr. Crosby. Mr. Lockwood entered the Theological Seminary of the Reformed Dutch Church at New Brunswick, N. J.

Mr. Lockwood had been privately married soon after graduation from the university, and still kept the fact a secret when he entered the seminary. He soon found himself without resources, and in his trouble had recourse to prayer. Ultimately the singular thought occurred to him, on which he acted at once, of going

to a business man in New Brunswick, who was not regarded as generous or liberal, and proposing a loan of one hundred dollars on his individual note. The proposal was accepted, and the financier, taking young Lockwood's hand in his own, wished him God speed.

Immediately after this transaction the seminarian went into a barber's shop, and, while waiting his turn, picked up a city paper which offered a series of premiums for the four best stories on a given subject. Reaching home, he told his wife what he had read. She said, "You must write for the first prize!" The story was written, and won the first prize. It was called The Treasure Hunters, and was written during the California gold fever, but bears not even a remote relation to the Argonauts.

Mr. Lockwood was graduated from the seminary and was licensed to preach in 1850. He received a call to the church at Cortlandtown, N. Y., where he remained only two years, employing for diversion his spare time in the pursuit of natural history, collecting insects and studying animals. In 1852 he was called to Gilboa, N. Y., where, located by the side of the Schoharie, he became deeply impressed with the fossil richness of the region.

A clerical agent for a benevolent society came to Gilboa, and after having succeeded, with Mr. Lockwood's aid, in securing the largest subscription ever given in the church for outside benevolence, was taken by him for a stroll in the fields and by the fossil beds. Mr. Lockwood spoke of the geological aspect of the region and of the great age of the Catskills, when the agent responded that it "was all the work of the flood." "Could the flood," asked Mr. Lockwood, "build up these stony mountains filled with shells for thousands of feet deep? . . . We will let the rocks speak for themselves." Picking up a soft stone from the stream, he dropped it on the rock at the agent's feet, when it broke, revealing a mass of Devonian trilobites. "Now," he said, "these fossils were deposited in quiet waters, and by no turbulent flood. So gently was each one laid by Nature in its bed to die, that not one of the delicate striæ that beautify it was injured or disturbed. But then, why should not the Creator have loved the beautiful before man was made?" "What! what!" exclaimed the agent; "death in the world before man was made? I see! You're an infidel!" The agent's society seems, however, to have overlooked this matter of infidelity, for it made Mr. Lockwood an honorary member in recognition of his services to it.

The young minister was soon reading other "sermons in stones."

Strolling one day along a high bank when the water of the stream was low, he observed some carbonaceous markings. With the aid of hammer and chisel these were proved to be relics of an

ancient flora. He extracted from the face of the cliff a bell-shaped stone, the lower part of which was more than three feet in diameter and the upper surface about two feet. It was the base of a shaft of a huge tree fern.

In 1854 Mr. Lockwood was called from Gilboa to Keyport, N. J., and he took with him a careful drawing of the big fossil. About two years afterward he revisited his haunts in the Schoharie Valley, when with other large fossils he removed the one just described, and presented it to Rutgers College. The moving of this mass—some thirteen hundred pounds—over thirty-seven miles of the Catskills was not without incidents. The young student was much annoyed, at points where the horses were fed, by inquiries about the "big stun." His paleontological lecture upon the rock as being the base of a wonderful plant rather puzzled the country people, as at Durham, N. Y., where the most rational theory that could be conceived to account for his proceedings was that the rock contained gold. This theory won respect for the geologist, who was now viewed in the light of a mining explorer.

Mr. Lockwood prepared drawings of his fossil plants, intending to send them to Hugh Miller, when the news came of the Scotch geologist's death. The fossils were studied and described by Sir J. William Dawson, of Montreal, and the descriptions with plates were published. The chief fossil received the name *Caulopteris Lockwoodi*, meaning Lockwood's "wing-shafted" tree fern. Each stem was a symmetrical column of sixty feet in height, with vast fronds like far outreaching wings.

Upon invitation of the late Prof. George H. Cook, then the New Jersey State Geologist, Mr. Lockwood presented the fossil to Rutgers College, with a speech, at a meeting of the Students' Natural History Society, in commencement week.

Mr. Lockwood reasoned out, without aid from books, to the conclusion that, though resembling the Carboniferous fossils, these Devonian plants must have antedated them; and that, though the rocks containing them were superficial in the Catskills, they probably extended, in Pennsylvania, beneath the coal beds. His interest in geology became from this time very lively.

In his new field in Monmouth County, New Jersey, Mr. Lockwood's attention was directed to the Cretaceous deposits known as the marl beds. They exhibited a new phase of organic remains in their vertebrate fossils, attesting to the former presence in the region of a race of immense reptiles quite as wonderful in their way as the Devonian cryptogams of the Catskills. During one of the visits of inspection which he was in the habit of making to the clay bluffs near Keyport, he observed what appeared to be the surface of a broken bone, black and friable.

Working very carefully, he extracted two enormous pieces of bone thickly coated with iron oxide—the distal ends of the fibula and tibia of some very large animal. Examining his find on the way home, he noticed a clean fracture, as if a spur had been broken from the bottom of the tibia, indicating a novel form. He returned to the bluff and extracted the missing piece. This bone was examined by Marsh and Cope, and figured by Cope and described by him as *Ornithotarsus immanis*, or "immense bird-ankled beast." The face of this ankle joint was thirteen inches and three quarters in the longer diameter; and the bones indicated an animal with long hind feet, like those of a bird, and short fore feet, that could stand up and browse upon the high trees of the forests in which it lived. Cope estimated the length of its hind legs at twelve feet.

Mr. B. Waterhouse Hawkins, an English artist skilled in the restoration of fossil forms, had come to this country and made some restorations of ancient gigantic animals—the Hadrosaurus, for instance, at the Academy of Sciences in Philadelphia, and at Princeton College. As he had made restorations of extinct English reptiles for a public park in England, it was thought that a good educational effect would result if a series of restorations of the so much grander extinct reptiles of the Cretaceous period of New Jersey could be set up in Central Park, and this gentleman was accordingly engaged for the project. He had a studio in New York city, where Prof. Lockwood visited him at his work. The artist's plan was, first to reconstruct the entire skeleton from the fossil bones, then to habilitate it in flesh by molding the clay upon it, so that the animal really had a true skeleton inside. Mr. Hawkins had already set up a Hadrosaurus when Mr. Lockwood called, but the visitor noticed that there was a break in the fibula. In answer to an inquiry about this omission, he was told that the beast had a singular articulation of this joint for which the fossil bones gave no data, and the artist had been unable to invent it. Mr. Lockwood modestly said to the artist:

"Why, I can articulate that for you."

Mr. Hawkins was incredulous, and seems to have continued so even after Mr. Lockwood told him he had the articulation at his house. Returning home, Mr. Lockwood made drawings of the part, the receipt of which set the English artist "crazy," as he expressed himself in a letter asking the loan of the bones. With their aid the difficulty was solved. Mr. Lockwood was afterward asked to sell the bones, to be given to the British Museum, but he preferred to keep them for America.

This incident was followed by a very curious psychological experience. Mr. Lockwood received from Mr. Hawkins an original cartoon of the Cretaceous dinosaurs, accompanied by a letter ask-

ing him to write a popular descriptive text to it. While his mind was exercised on this subject he was attacked by a violent fever, culminating in delirium. In this delirium he dreamed of a terrific battle of saurians, in which all the giants of the family took part. After recovery from his illness Mr. Lockwood wrote the dream down, and it proved a very satisfactory libretto to the cartoon.

While Mr. Hawkins was still engaged in his saurian reconstruction in Central Park, the "Tweed Ring" rose into power, and, not appreciating the value of this scientific labor, or rather not caring for it unless it was re-enforced by the kind of consideration acceptable to political bosses, ordered the figures, representing the patient labors of two or three years, destroyed. Prof. Henry, of the Smithsonian Institution, intervened to prevent this devastation, but he had no hearing.

Mr. Lockwood's residence at Keyport gave him opportunity to study ichthyic life. As a first result of his researches in this new field appeared his article in the American Naturalist, The Sea Horse and its Young, which describes the remarkable fact that the male fish takes from the female the eggs and places them in an abdominal pouch, in which he carries them until they are hatched. It was upon this discovery, published in 1867, that the University of New York conferred upon her alumnus the degree of Ph. D. Some studies on insects at this time led to economic results.

After reading a paper before the New York Lyceum of Natural History on A New Parasite in the Eel, the society requested the doctor to take up the study of *Limulus*, the horsefoot or king crab. Dr. Lockwood was promised the loan of a compound microscope for the purpose, but this he did not get, and did his work with an instrument which cost but three dollars. The paper was read to the society in 1869, and published in the American Naturalist in 1870. It showed that in one of its embryonic forms *Limulus* is a trilobite. Dr. Lockwood also demonstrated that in successive months of its larval life it went through further phases representing those higher fossil forms known as *Pterygotus*. The author furnished eggs to Prof. A. Packard, who sent some to Jena. The article in the American Naturalist attracted much attention, and pointed out the way to a number of eminent workers on the problem who were able to use the best appliances. Dr. Packard led; then Prof. Dorhn, the biologist of the University of Jena, who translated the Lockwood article into German. Dr. Richard Owen, the eminent English anatomist, occupied two evenings of the Linnean Society of London citing largely from the article and complimenting it. The paper received praise also from Milne-Edwards.

In his studies in fishes, besides some abstruse problems which he attacked, not always with equal success, Dr. Lockwood gave a charming lecture on sticklebacks, which included some descriptions of their nesting and the raising of their young. He also made some discoveries among the mollusks. But perhaps his most extended labor was devoted to the oyster, as is shown in his report published by the State of New Jersey. Upon this subject as a lecturer and writer he won great applause and enduring fame. An amusing incident, which was at the same time a compliment, occurred some years ago when Dr. Lockwood was lecturing on The Life of an Oyster. Two oystermen, at the conclusion of the lecture, got into audible discussion over what they had heard. Said one to the other, "I tell you, Ned, he knows it all, from the cedar on Lebanon down to soft clams!"

Dr. Lockwood's studies were not confined to fishes, but he examined and investigated zoölogy generally. There is also a third phase in his scientific character which must not be omitted. His discovery of the fossil plants in New York led him into the study of living plants; hence he was not without reputation as a comparative botanist. He seemed to see all things as a unit—nothing unrelated—Nature as the oneness of the Infinite Maker. His knowledge of these several fields, which was sharply defined and comprehensive, and his simple yet almost poetic generalization, made everything from his pen attractive to the popular reader.

But back of all was a devout mind, with an overflowing love of any and every living form, animal or plant. In his study his aquarium was always an attractive object to visitors. He even had a little froggery, where different species of frogs enjoyed themselves. Snakes and lizards, too, entered into his friendship, and afforded him opportunity for the study of their habits. Then, with all these, there seemed to be a pathological instinct in the good man's heart. As a microscopist he investigated the diseases of fishes and of plants.

He was fellow of the American Association for the Advancement of Science, President of the American Microscopical Society, and President of the United States Hay Fever Association. His latest contribution to the Manual of the last-named association was an article on The Comparative Hygiene of the Atmosphere in Relation to Hay Fever. An article of similar character was reproduced, together with the plate from the original, abroad, where Dr. Lockwood was well known among scientists, and was an honorary member of the Belgian Microscopical Society.

Speaking of his aquarium, the writer on one occasion observed in a north room of his study several small aquaria, which were the quarantines to which he intrusted the sick animals while making every effort to save them. These aquaria seemed to be

divided into sanitaria for different kinds of maladies. On a later visit the doctor was found going over a large number of mounted slides for the microscope which he had prepared, containing fungi and microbes taken recently from sick fishes. Dr. Lockwood's general and specific knowledge in so many fields, with his well-known love for the young and his lifelong experience as an educator, may readily account for the indescribable charm of his writings; but perhaps especially are these features discovered in his two little volumes of Animal Memoirs, of which a third volume, to embrace the reptiles and fishes, was to follow in due course.

Dr. Lockwood lived to be about seventy-five years of age, but time had dealt so kindly with him that his mind seemed to be expanding and ripening as the years went by. His tenacity of purpose in the pursuit of knowledge continued to brighten an intellect that was never dull, while his conversation glowed with the enthusiasm of youth and charmed with a delicacy of thought that was intellectually refining and pure. He was ever a student, but never a recluse. Seated by his beloved microscope, he seemed to play upon science as a master of the violin feels for its magical chords, and he caught by his sympathetic comment upon insect and animal life the attention of his hearers and held it firmly and harmoniously in touch with his own. His fondness for clearness of speech brought him the admiration of those who know science only by name, and his geniality and hospitality won for him the love of all who came within the circle of his home. In his home life he was ever gentle, considerate, and kind, and his love for his work was as absorbing as the simplicity of his life was sweet.

ONE cause of the persistence of caged birds in singing is found by Mr. Charles A. Witchell in the result of their changed condition of life—that they have nothing to do but to sing. "The wild bird has always plenty to notice and consider—the approach of various creatures: men, beasts, hawks and other birds; the sounds which these produce, and which signify various degrees of safety or of peril; the indications of food in air or tree, or on the ground; and lastly the state of the atmosphere and the various weather signs which all birds observe—such incidents as these occupy the wakeful hours of the wild bird. But the caged bird—often secluded from all communication with his kind (one, perchance, of a gregarious species), without the necessity of seeking food, with a horizon limited perhaps by a smoky garden, perhaps by a dingy window—can take no exercise but in hopping from perch to perch, across and across his cage, and can hear no call-notes but his own, which he repeats again and again, and, if he has been reared in a cage, his own song, which he seems to utter as much for the sake of such occupation as it affords as to express by means of it any desire for a mate or any pleasure in his surroundings."

Correspondence.

THE DEPARTMENT STORE.

Editor Popular Science Monthly:

In the July number of the Monthly, under the head of A New Social Problem, you discuss the department store. I was interested in your application of the fundamental laws of evolution to its development. From an evolutionist whose views do not fully accord with your own will you permit a query or two?

I live in a city in which the first business started was a department store. It was owned and conducted by a wealthy man who was eager for more wealth. Now, how did it happen that his ability to purchase large quantities of goods, the saving of rents, etc., failed to prevent a differentiation and segregation into the little specialist? Has not this been the general course of all communities in this country? First, settlement was made at some point, and the man with a general assortment of commodities put in his appearance. If population became permanent and sufficiently large, differentiation and segregation took place, and the whole became integrated along the street or streets best adapted to business.

Now, what has caused a reversal of the process? The economies mentioned in your article manifestly are inadequate to explain the matter, since all of them have been in operation from the beginning. Take, for instance, the ability to make large purchases for cash. Is it not a well-known fact that the discount to-day in such transactions is less than at any former time? The discount has but two factors—interest and commercial risk. Rates of interest are less than at any former time, while commercial reports are more readily obtainable and more trustworthy than ever before.

Evidently some new factor must be considered, as the forces with which you deal have been in operation for all time. Nor can this new element consist of knowledge of advanced business methods, since it can be shown that we to-day are familiar with no business process not known from the dawn of civilization. This new force, in my opinion, is not far to seek. Is it not true that a high rate of taxation wherever applied has had the effect to concentrate the business in the article so taxed? We need but recall the match, the tobacco and the whisky interests. Now, have we not a new element in the high property tax rates of modern municipalities? They certainly are new, as their equal was never before imposed.

Space will not permit tracing the operations of this new force. But when we observe a direct relation between a high property tax rate and business concentration, we are impressed with its potency. I will instance Chicago. Here we find the highest tax rate of all the principal cities of America; here the department store has attained its greatest development.

From my standpoint, when viewed in connection with the community as a whole, the department store is a dissolution to which the laws of evolution apply precisely as they do to a cancer. It has for its cause the ability of the owner to escape the progressively increasing burden of state. This is effected by making the business so large and complicated as to be beyond the comprehension of the average assessor. The small dealer has no such refuge. The public patronize his rivals in order to obtain untaxed goods. "Only this and nothing more."

The cure is obvious. Remove all tax from personal property (at least), thus giving the small dealer a free field and fair play. This is all "wise legislation" can or should do for him.

S. L. Beeler.

Hamilton, Ohio, *July 20, 1897.*

Editor's Table.

A WOMAN ON WOMAN SUFFRAGE.

If the right of women to vote in political elections depended on a demonstration of their ability to think clearly and conduct an argument in an orderly manner, the book which Mrs. Helen Kendrick Johnson has published under the title of Woman and the Republic (Appletons) would settle the question. It happens, however, that Mrs. Johnson is not a woman-suffragist, but that, on the contrary, a wide historical study of the subject has led her

to the belief that the party which is laboring to convert women into voters is threatening serious injury to the state both in a political and in a social aspect. Her argument is a very comprehensive one, as a glance at the titles of her chapters will show; and at every point she arrives at the same conclusion, namely, that the woman-suffragists have raised false issues, put forward false pretensions, and generally gone about as far wrong as it was possible to do. We believe—having read the book attentively—that it is destined to have a potent influence in the settlement of the question with which it deals.

The first thing that strikes us in connection with Mrs. Johnson's argument is the high ground she takes on woman's behalf. If she does not claim the suffrage for women it is not that she deems them incapable of forming correct judgments on political questions; not because she recognizes any mental inferiority whatsoever on their part, but because she believes that they constitute that portion of society in whose interest chiefly all laws are enacted and the whole machinery of politics is kept going. We are hardly mistaken in saying that she considers that in the development and perfection of woman the life of society finds its highest significance. The poet Clough had the same thought when he said that men might well

> Perish in labor for her, who is worth the destruction of empires.

The advocates of the suffrage for women will therefore have to attack Mrs. Johnson on other grounds than her depreciation of the female sex. It is they, according to Mrs. Johnson, who depreciate the female sex in asking woman to enter upon a struggle for a position actually inferior to that which she already possesses, a position in which, instead of assuming, as she now may, that laws are made especially for her benefit, she will proceed on the contrary supposition that she can not get common justice unless she wrenches it from man at the polling booth.

Our own view of the general question has been more than once stated in these columns; and it is with pleasure we note how close the agreement is between what we have said, writing from a masculine standpoint, and the conclusions of the book before us, written by a woman jealous for the honor of her sex and instinct with true feminine feeling. Mrs. Johnson perceives, as we do, that law-making means nothing else than the laying down of rules of conduct which are to be enforced, if necessary, by physical compulsion, and that unless we want women to take up cudgels in the most literal sense for the enforcement of laws we should not ask them to take part in making them. Those who vote for laws should not only be possible combatants, but should be individuals whose natures would not be essentially injured by actual physical conflict. Women are *possible* combatants, as the suffragists sometimes remind us, but the essential nature of woman would be injured by participation in physical conflicts. Why can we tolerate prize fights between men, while prize fights between women fill us with horror and disgust? Is it not because Nature itself tells us that whatever woman's physical strength may be—and suffragists sometimes remark with their customary acuteness that some women are stronger than some men—it is not meant to be exerted in delivering blows? But if a prize fight between two women is horrible to think of, what language could be applied to a prize fight between a woman and a man, however evenly

they might be matched? Surely "woman's rights" stop short of that. If voting meant merely the collecting of opinions, no one would dream of refusing the votes of women; but so long as it means the determining and arraying of *forces*, which must in the last resort be physical forces, something else than an instinctive desire to tyrannize may well inspire the men who do not wish women to vote. As to the women who do not wish to vote, the simple answer they have to give to inquiring committee women is that they know "a more excellent way."

If the book to which we are referring has a fault it is that it is too argumentative. The author seems to have made up her mind to achieve a victory at every point, and has consequently entered on one or two discussions which might perhaps have been advantageously omitted. We doubt whether it was very necessary to prove that aristocratic institutions are more favorable to the political prominence of women than democratic ones. It is enough to prove, as we think the author has done, that there are reasons for believing that the participation of women in the suffrage to-day, far from improving the constitution of society, would tend to impair it. It was useful, however, to insist that there is no connection between the democratic theory of society and the extension of the suffrage to women. It would be an insult to the female sex to maintain that, in the progressive lowering of the conditions for the exercise of the electoral franchise, women ought to be taken in; or even that, because the franchise is very widely bestowed, women ought to possess it. These unflattering arguments are more or less used by the advocates of woman suffrage; but those who have a truer sense of the position and claims of women perceive that it never can be a question of conceding any right to her *after* men have obtained the same right, or even *because* they have obtained it; whatever is a woman's right belongs to her whether men have it or not.

How odiously in certain cases the suffrage party have stated their position is well shown by Mrs. Johnson in the following paragraph:

"The argument for woman suffrage which bases it upon a fancied grouping of women with the vile and brainless element in the country appears to me at once the weakest and the meanest of all. When the United States Government invited its women citizens to share in making the Columbian Exposition the most wondrous pageant of any age, the National Suffrage Association, at its official exhibit, gave a picture of the expressive face of Miss Willard surrounded by ideal heads of a pauper, an idiot, and a criminal, with a legend recording their belief that it was with these that American men placed American women. So false a picture must have taught the thoughtful gazers the opposite lesson from the one intended. It could have told them that the United States Government had at least guarded one trust with sacred care. The pauper was excluded from the ballot as not being worthy to share with freemen the honor of its defense. The unfortunate was excluded by an inscrutable decree of Providence. The criminal was excluded as being dangerous to society. The women were exempt from the ballot because it was for their special safety that a free ballot was to be exercised from which the pauper and the criminal were to be excluded. They were the ones who have given to social life its meaning and its moral, the ones who give to civic life its highest value."

The writer lays proper stress on the fact that the occasions are not so

rare when the authority of law has to be maintained by force, and correctly draws the inference that it would be dangerous to mix up with those who, by their votes, make the laws a large number of non-combatants. We do not find, however, as distinct a recognition as we could wish of the fact that not only *are* laws founded in the last resort on physical force, but that, in the interest of liberty, it is desirable that they should be so founded—that physical force should be fully in view as the final arbiter between those who favor a law and those who are opposed to it. The reason is obvious: if a law *may* have to be fought for, and if there is nothing to deter those who object to it from fighting against it, if it seems unduly to infringe their liberties, and provided they feel themselves strong enough, there will be a reasonable parsimony in the passing of laws, and individual liberty will be the gainer. If, on the other hand, the idea of armed resistance to any law which has once been passed dies entirely out, there will be no bounds to the tyranny of majorities. This is the condition of things which the sharing of the suffrage equally between men and women would tend to bring about. Even to-day laws are being passed, in this country particularly, in vastly too great number, precisely because the instinct of resistance to unjust or unnecessary laws is already weaker than it should be. If we could be sure that it was always "the common sense of most" that kept a "fretful realm in awe" there would not be so much reason to complain; but we have no reason in many cases to suppose that there is anything more than a common desire on the part of a majority to have their wishes and fancies imposed upon others. Men seem to be approximating to women in their belief in compulsion: add the female vote, and liberty, in any wholesome sense, is at an end.

We trust that Woman and the Republic will be widely read and deeply pondered. One advantage which the suffragists possess is that the arguments they use, though very superficial, are specious in their simplicity. It is so easy to ask whether women are not as good as men, whether they are not as cultivated, whether they are not as intelligent; and when affirmative answers are given to these and similar questions, it is so easy to draw the inference that they ought in that case to have equal voting power. The result is that unwary persons are apt to be carried away to an acceptance of the suffragist position. Many men, and some of no mean note, have been so carried away; but the remedy for the error is to look deeper and consider society in its organic character. Prof. Goldwin Smith, as quoted by Mrs. Johnson, expresses the fear lest, through the "feeble facility of abdication" which prevails in a revolutionary era like the present, men may give way to the demands that are being made by the woman-suffragists. Mrs. Johnson shares the fear, but sees also a source of danger in "the very tender-heartedness of the men of our time," adding that, "so far from desiring to hold the slightest restriction over the women of the republic, they may rush into an attempt at abdication of a sovereignty that did not originate in their will, but in their environment, in order to prove the sincerity of their desire that woman should not even *appear* to be compelled to obey." For our part we share both fears; but our special dread is lest the intellectual superficiality of our time should lead to the acceptance of arguments which move, as it were, in one dimension only, the dimension of abstract rights. Any logic-chopper can deal with ab-

stractions, and make of them what he or she likes; it requires a more philosophic mind and vastly more patience and attention to deal with concrete facts and organic systems. Mrs. Johnson's book will repay a careful perusal and reperusal. Whatever errors she may have fallen into upon points of detail—and it is almost impossible that, dealing with so vast an array of facts as she has done, she should not have fallen into some—she has got to the root of the matter. Her formula for man and woman is not, as with the suffragists, *2a*, but *ab*, each the coefficient of the other, and both together forming a compound unity. Her book rests on the solid ground of Nature, and will survive many dreary diatribes of the *2a* school of social reformers.

THE DICTUM OF A PHILOSOPHER.

MR. THOMAS DAVIDSON is by all accounts a philosopher. He is profound in Aristotle and Rosmini, and can tell to a shade just where Kant failed to grasp the problem of human knowledge. He has written magisterially on the subject of education. He is therefore a man whose utterances ought to be marked by a very superior wisdom, particularly on the subjects which he claims to have made his own. Strange to say, however, we fail to see any great wisdom, or even, to put it plainly, [illegible]n sense in a remark in which he indulges in the July Forum. He there discusses the changes that have taken place in England during the last sixty years, and, in doing so, takes occasion to say that "the education of children, which formerly was let out to teachers as the washing of clothes was to washerwomen, is now regarded as a matter *demanding the careful attention of parents.*" If this means anything it means that the giving of clothes to a washerwoman to wash may be taken as a typical instance of a matter that does not receive careful attention—a matter about which people are proverbially indifferent.

Now, we do not claim a very profound knowledge of the household diplomacy which results in the making of treaties with washerwomen; but, so far as any echoes of the proceedings have reached our ears, we have received an impression that very considerable interest is taken in the choice of an efficient washerwoman, and that the subsequent performance of the person selected is watched with close attention. We have reason to believe that questions are very frequently raised as to whether the clothes have been properly treated in the washerwoman's hands; and that if they come back unsatisfactory in color, badly ironed or folded, or showing signs of excessive use of alkali, sharp remonstrances are made. If the case is serious, the clothes are not again given to the inefficient or destructive operator, but search is at once made for one who will do the work better. If we are not up to date in our notions on this subject, we are sorry for it; all that we can say is that it used to be so. What are we to say, then, to the learned professor's typical example of slipshod indifference? Only this, that it was very ill-chosen, and that the professor is evidently more at home on the dizzy peaks of a transcendental philosophy than in the region of domestic economy.

The real truth is that, in these advanced days, a contrast might well be drawn between the care and sense of personal responsibility people manifest in getting their clothes washed and the easy-going confidence and careless irresponsibility with which they send their children to be educated. One reason for the difference is that they pay directly

for the former, and only indirectly, and in a manner they can not control, for the latter. In the former case they want to get value for the money they pay out; in the latter case if they don't get value they can not do anything about it; the whole thing has passed beyond their control, and is largely in the hands of ward politicians. So the children go to school and come home; and the average parent hardly asks what they have learned or whether they have learned anything. It was long ago remarked by Adam Smith that "the proper performance of every service seems to require that its pay or recompense should be as exactly as possible proportioned to the nature of the service." That is the case with the washing of clothes, but it is not the case with the education of children. The parents who pay the money have nothing to say as to the quality of the article they get in return; and superintendents and trustees are only able to a very imperfect degree to proportion compensation to the amount of useful work done. Upon the whole the "washerwoman" system has its good points; and, disagreeing with Prof. Davidson, we should be very glad if it could be made applicable to the whole business of education.

THE DEPARTMENT STORE.

A CORRESPONDENT regards as inadequate the recent explanation given in these columns of the origin of the department store. Instead of attributing it to the economies it effects as a piece of labor-saving machinery, which has come into existence under the operation of the law of evolution, he ascribes it to the influence of the heavy municipal taxation that prevails in the United States. In proof, he cites the failure of the department store, or rather the country store, in new communities to prevent the growth of the specialist. He cites also the city of Chicago, saying that "here we find the highest rate of taxation of all the principal cities of America," and the highest development of the department store.

That heavy taxation, as was shown in the case of the match and whisky industries during the civil war, tends to concentrate business in a few hands with large capital we would not deny. Nor would we deny that such concentration is abnormal and injurious. But while we are willing to admit that further municipal taxation in this country has become very heavy and ought to be materially reduced instead of increased, as the tendency is, owing to the extension of the sphere of government, we are not convinced that it has become great enough to produce the department store. Were that the case, the department store would not be the only form that the concentration of capital would assume. Other industries, subjected to the same influence, would also become consolidated. But, as yet, we have heard of no complaint of this kind. What convinces us that this view is correct is the fact that the rate of taxation in Chicago, where the movement against the department store has assumed the greatest proportions, is not higher than in many other cities where there is no serious complaint against this form of industrial development. A reference to the Abstract of the Eleventh Census and to the World Almanac will show that the rate of taxation in Boston, New York, Cincinnati, Baltimore, San Francisco, and elsewhere is higher than in Chicago.

The failure of the so-called department store in new and growing communities to prevent differentiation and segregation is not difficult to explain. In such communities

the retail trade is not, as a rule, in the hands of men of commanding ability and enterprise, alert to seize every opportunity to extend their business. If they do possess these qualities, they either go into some other business or move to a larger town. The consequence is, that in the smaller towns the business of the general merchant does not grow beyond his limited capacity. If it does, there are differentiation and segregation. Men more capable in certain lines set up drug stores, grocery stores, hardware stores, etc. But when there is a large concentration of population, making a concentration of trade so profitable as to attract men of the highest ability, then the department store proper is certain to make its appearance. It should be remembered, moreover, that such a store, like any valuable labor-saving appliance effecting important economies, has to be discovered by some superior mind. Only within recent years has any one thought it possible to unite deliberately under one management a large number of forms of retail business. But, as we pointed out in the article criticised, there appears to be a certain limit to this phase of industrial development, thus making superfluous the efforts of the "new" social reformers to cure the "evil." Even if it were due to heavy taxation, as our correspondent suggests, the remedy would be simply a reduction in public expenditures.

Scientific Literature.

SPECIAL BOOKS.

THE author of *Bird-life** will not be offended if we begin our description of his book by a mention of the illustrations, for he has himself expressed his high appreciation of Mr. Thompson's remarkably spirited and accurate portraits. There are seventy-five full-page plates representing birds described in the text, with natural surroundings and in characteristic poses. Twenty-five smaller figures are scattered through the preliminary chapters. Mr. Chapman begins by pointing out the position of the birds with respect to the other classes of the animal kingdom. The different forms of the chief external organs in different birds he shows to be adapted each to a special habit, thus affording confirmation of the doctrine of evolution. He represents the interest of man in birds as threefold—scientific, economic, and æsthetic—and presents definite evidence as to the value of the small birds in destroying insects and the seeds of weeds, and of hawks and owls in keeping down field mice and other vermin. Some of the scientific aspects of the coloration of birds are pointed out in another chapter, and the migrating and nesting habits are similarly treated. Coming to the subject for which the book will be most in request, Mr. Chapman insists on definite observation of a bird as the first requisite to its identification. Having noted down the form, color, and markings of the bird, and such added facts as to its voice and actions as may be obtained, the amateur should be able, by means of the author's field key of eight pages and the detailed descriptions that follow, to identify the specimen without

* Bird-life. A Guide to the Study of Our Common Birds. By Frank M. Chapman. With Drawings by Ernest S. Thompson. New York: D. Appleton & Co. Pp. 269, 12mo. Price, $1.75.

difficulty. The descriptions are attractively written, and embrace over one hundred of the commoner birds of eastern North America. "There are results to be derived from the study of birds," Mr. Chapman remarks, "that add to our pleasure in field and wood, and give fresh interest to walks that before were eventless; that quicken both ear and eye, making us hear and see where before we were deaf and blind. . . . I would enter a special plea," he continues, "for the study of birds in the schools; for the more general introduction of ornithology in natural history courses. Frogs and crayfish serve an excellent purpose, but we may not encounter either of them after leaving the laboratory, whereas birds not only offer excellent opportunities for study but are always about us, and even a slight familiarity with them will be of value long after school days are over."

The character of history is undergoing a most gratifying elevation. Formerly its chief function was to chronicle battles, assassinations, and slaughters, but it is coming more and more to depict the social, political, economic, and intellectual progress of man, to which wars are deplorable interruptions. In describing that movement of thought whose culmination is the greatest intellectual event of the nineteenth century, Mr. *Clodd** is writing the highest kind of history. No theory of the first rank has ever sprung complete from the brain of one man, hence it is not strange that conceptions leading up to the doctrine of evolution were formed in the minds of philosophers who lived in the intellectual day that preceded the dark ages. Following Prof. Burnet's Early Greek Philosophy in his survey of the thought of this time, Mr. Clodd takes the belief of Thales that each thing is formed by a change from something pre-existent as the earliest recorded germ of the evolutionary theory, and points out developments of this idea in the writings of other philosophers down to Lucretius. After Lucretius came the period denoted by our author as the Arrest of Inquiry, extending from A. D. 50 to A. D. 1600. Toward the end of this period Columbus, Copernicus, Vesalius, Brahe, and Bruno appeared as forerunners of the renascence of science. From 1600 to about 1830 the work contributing most conspicuously to scientific progress was done by Linnæus, Buffon, Cuvier, and Lamarck. Buffon taught the nonfixity of species and Lamarck worked out a general theory of descent. At and after their time lived two or three men who are remembered not for any constructive work that they did in science, but for being "anticipators of Darwin," because they stated, without proofs, an outline of the evolutionary doctrine earlier than 1858.

But it is modern evolution in which Mr. Clodd's readers will be most interested, and he does well to devote full half of his volume to the work of Spencer, Darwin, and Wallace, and their exponent Huxley. Beginning with Darwin, the author tells the chief events of his life, giving the dates when his notable statements as to organic evolution were made and describing the reception that they met with. Each of the others is treated in a similar way, and, in the case of Spencer, dates are given which prove that he had formulated the general doctrine of which Darwinism is a part before the views of Darwin and Wallace were made public. In describing

* Pioneers of Evolution, from Thales to Huxley. By Edward Clodd. New York: D. Appleton & Co. Pp. 274, 12mo. Price, $1.50.

the work of these men and giving a general view of their relations to each other—both intellectual and personal—Mr. Clodd has performed a valuable service. He seems to be solicitous—perhaps more so than becomes one of a victorious party—to refer to the obstacles that theologians have vainly thrown in the path of the evolutionists, and to point out the positive statements in the Bible which modern knowledge no longer permits to be accepted literally. His chapter on the Arrest of Inquiry is, for the most part, an effort to show that the Christian religion was "an arresting force in man's intellectual development—the chief barrier to the development of Greek ideas." We can not accept this view. Christianity is no more the cause of the dark ages than it is of the enlightenment that has followed them. Both are stages in the evolution of mankind in which Christianity has degenerated and has achieved a new birth side by side with science and philosophy and art. He takes unnecessary pains also to state the religious views, or the lack of them, of the men whose work he describes. This will seem to many a blemish on an otherwise instructive and attractively written book. Excellent portraits of Darwin, Wallace, Spencer, and Huxley add to the value of the volume.

GENERAL NOTICES.

No attempt to solve fundamental questions is indulged by the author of this book.* His efforts are devoted to exposing the fallacies of those who become ingulfed in biological theory. He examines their methods critically, and generally disapproves of them. There is inner confusion in the science of biology on account of its form, which embraces numbers of independent systems, each with a core of facts. There is outer confusion, because of its ambiguity of terms. The structure of to-day is the function of to-morrow. The favorite inquiries—Are acquired characters inherited? or, Is variation purposive?—are misleading. He asks what quality is not inherited, or not acquired; or, find anything organic not purposive. For the discussion he defines biology not as an encyclopædia of facts about organisms, but as including the systems of explanation of the forms, functions, and origins of animals and plants. He finds twenty good theories of the development of the individual, not any one better or worse than the rest. All biological systems are considered as involving three postulates—the independence of qualities, the doctrine of agents, and theories of the use and adaptation of structure. Under the first head we are confronted with the fact that groups of qualities are inherited together. The theories, however, ignore what they call the correlation of qualities and escape by means of terminology; two qualities invariably combined are one. So, in regard to the cell theory. The fact that every thing living is a cell, or a colony of cells, is usually so stated as to evade the problem of the individual. "Functionless parts" and "latent qualities" are also biological bewilderment, and "a mathematical, chemical, or physiological formula for the character of a species is an attractive but vain dream." According to the second postulate, the qualities of the organism are related to one another through an agent. This may be "a material vehicle of hereditary qualities," or a "quasi-psychical principle." The epigenetic theory avoids both of these suppositions, and is deemed by the author the critical point of view. He gives an outline of the theories of the preformationists, or "biologists of hypothesis" as he terms them—De Vries, Spencer, Weismann, Naegali, and Brooks—and pronounces Mr. Spencer's, in two respects, the most serious and credible of all. Yet this contains a self-contradiction on the point of identity and fails to give us individuality. The third postulate supports the adaptation and transformation of species and cruder forms for the doctrine of design. "As ridiculously

* Problems of Biology. By George Sandemann. New York: The Macmillan Company. London: Swan, Sonnenschein & Co. Pp. 213. Price, $2.

inapt for science, as that grass grows for cows to feed upon." Theories of organic evolution arose from an effort to combat this philosophy. Everything organic exists by reason of its significance to the organism, but it does not do so through the Darwinian or other apparatus. As to the struggle for existence, the author judges that the view of this conflict is, "as regards Nature, quite gratuitous, and, as regards science, quite abstract." Biologists, however, do not monopolize the conception of a struggle. "Ideas are represented mobbing round the trapdoor under the stage." Motives, faculties, tendencies, movements, all wrestle together. "In all these cases the *struggle* is not what happens, or what we see, it is the result of the struggle. We have to do with a hypothetical process which we do not observe, and the nature of our judgment is that we mistake ideal abstraction for physiological analysis. The concluding chapter is upon the unity of the organism. The beginning and end of our labor is to find an expression for character. What is it, as distinguished from the characteristics? No answer to this problem is suggested, except by the biological theories which have been dissected. The author did not aim to construct, but to show what errors are developed through the needs of speculative systems. The book is thus mainly an addition to the voluminous literature of biology, and it serves well as a corrective to an overdose of theoretical abstractions.

A pamphlet of about sixty pages, presenting a new hypothesis concerning the structure and rotation of the earth, modestly published by *Carl Freiherr Loeffelholz von Colberg* at Munich in 1886, has passed through a second edition, and now appears thoroughly revised and enlarged as the exposition of an elaborate theory.* The theory is that the crust of the earth, through the natural difference in the action of the sun's attraction and centrifugal motion upon the two parts, has a motion of its own, different from that of the fluid nucleus beneath it, causing it to slip over it to a greater or less extent, and giving rise to a variety of phenomena which have been observed, but not hitherto explained. In this way the author would account for the shiftings of the pole which geologists have had to suppose; for the changes of climate of which evidence is given by the fossils, particularly by the subtropical fossils in the arctic regions, and —probably—for the nutations in latitude which are now under investigation. He assumes that it is a strong evidence in favor of his theory that it contradicts no natural laws or phenomena so far established, but is entirely in harmony with most geological and biological and many astronomical observations.

Although the author states that this work* must not be considered as a petrology, he devotes nearly half of it to describing the several varieties of igneous, aqueous, æolian, and metamorphic rocks, telling how they occur, and what are their constituents. Both the macroscopic and microscopic structure of these rocks are shown in photo-engravings from specimens, and their chemical constitution appears in the results of many analyses. The especial purpose of the work is to set forth the processes and results of the natural decomposition of rocks exposed to the atmosphere. After describing the chemical action of water and the air, the mechanical action of water and ice, and the effects produced by plants and animals, Prof. Merrill proceeds to discuss the weathering of typical rocks in special cases—for instance, a granite in the District of Columbia, syenite in Arkansas, diabase in Massachusetts and Venezuela, basalt in Bohemia and France, diorite in Virginia, etc. Various physical conditions that affect the weathering process are next discussed, such as position, exposure, surface contours, structure of rock masses, etc., and there is also a chapter on the rate of weathering as influenced by such conditions and by climate, topography, etc. The remaining hundred pages of the work are devoted to a description of the regolith or body of soils that mantles the solid crust of the globe. The author points out the various kinds of de-

* Die Drehungen der Erdkruste in geologischen Zeiträumen (Revolutions of the Earth's Crust in Geological Ages). A new geologico-astronomical theory. By Carl Freiherr Loeffelholz von Colberg. Munich: J. A. Finsterlin's Successors.

* A Treatise on Rocks, Rock-Weathering, and Soils. By George P. Merrill. New York: The Macmillan Co. Pp. 411, 8vo. Price, $4.

posits of unconsolidated material that make up the regolith, and tells something of their chemical, mineral, physical, and other characteristics. The volume contains a total of twenty-five plates and forty-two smaller figures, and the mechanical execution of both illustrations and letterpress is excellent.

The secret of Darwin's strength, according to Prof. *Poulton*,* lay in the perfect balance between his powers of imagination and those of accurate observation. His hereditary endowment unquestionably fitted him to become a typical scientific discoverer, whether or not this nice adjustment of the creative and critical faculties would have produced equally well a poet or a historian, as it is claimed here. It is a noteworthy example, however, of the immeasurable stimulation of thought that both Darwin and Wallace should ascribe to a reading of Malthus's Essay on Population the discovery of the principle of natural selection. Wallace constructed almost the whole of the theory in two hours, and in three evenings finished his paper on the subject. Darwin devoted four years of study to the hypothesis before writing it out fully, two years more to the collection of further data and enlargement, and after fourteen years of deliberation gave the theory to the public in the Origin of Species. The effect of this doctrine upon Lyell, Gray, Hooker, and other scientific men, the misunderstanding and opposition it incurred, the position of Huxley in regard to it, and his noble championship of the fundamental truth of evolution, are topics of especial interest discussed by the author. Brief accounts of other works of Darwin, some letters not heretofore published, and an index are also included in the volume, which, for the most part, was first given during 1894 and 1895 in the form of lectures in Oxford University Museum.

A most valuable and scholarly contribution to Egyptology is *Religion of the Ancient Egyptians*, by *Alfred Wiedemann*. Written by a professor in the University of Bonn, the subject is handled with German thoroughness and accuracy. He does not theorize on the religion, maintaining that to be fruitless in our present limited state of knowledge of the subject; he investigates the data found in the records and inscriptions concerning the beliefs of a people whose whole life was dominated by religion. The writer's aim "is a modest one; avoiding any attempt to interpret or to systematize, he has endeavored to set before the reader the principal deities, myths, religious ideas, and doctrines as they are to be found in the texts, more especially dwelling on such as have important bearings on the history of religion." The worship of the sun occupying an important place in the Egyptian ritual, the sun god Ra is discussed at some length, together with the solar myths, and the subordinate deities entering into them. There are chapters devoted to the other deities, both domestic and of foreign origin, the worship of animals and plants, Osiris and his cycle, and the Osirian doctrine of immortality, magic, sorcery, and amulets. The author has admirably succeeded in getting order out of the complications of the Egyptian pantheon in which the many deities of the numerous provinces entered, each province claiming superiority for its own deity. Many passages have been translated from the Book of the Dead, hymns and sepulchral texts, and numerous illustrations from the monuments accompany them.*

The author of I Diseredati † believes that outer material influences, instead of being the single predominant factor in social phenomena, as is commonly believed, are only one of several concomitant elements of which the social fact is the resultant. He seeks to present in their exact proportions the importance of the material element in social development, and the influence exercised by it upon the institution of property. The error pointed out is supposed to be accompanied by grave consequences in legislation and practical life. In the former, civic capitalism has been created, and the doctrine has been inculcated that the state should provide for everything, depriving the individual of his initiative and responsibility. The institution of wages is condemned as disor-

* Charles Darwin and the Theory of Natural Selection. By Edward B. Poulton, F. R. S. New York: The Macmillan Co. Pp. 224. Price, $1.25.

* The American supply of the work is imported by G. P. Putnam's Sons, New York, 1897.

† I Diseredati e i loro Diritti (The Disinherited and their Rights). By Pietro Pellegrini. Borgo a Mozzano, Italy.

ganizing to the family, demoralizing to the workman, and making his future uncertain; and by the institution of rents and the system of day's work, the peasant is made as proletary, as separate from his family, and as destitute of a morrow as the workman in the shop. Thus pushed out of society, such individuals demand a new social order. Society dismayed contrives laws to meet the demands of the workmen for relief, and thus assists in establishing the collectivism which the socialists invoke. Socialism is consequently an evolution or degeneration of capitalism. This evolution is right if it conforms itself to the laws of being, wrong if it does not take account of them. The author's purpose is to show how the necessary, evident, and near evolution of capitalism may take just forms, which, not depriving any, will give their rights to all, particularly to the disinherited; creating a new judicial and social order upon the existing physical order, but unknown to it.

The New York State Library has just issued its seventh annual *Comparative Summary and Index of State Legislation*, covering the laws passed in 1896. Each act is briefly described or summarized and classified under its proper subject head, with a full alphabetic index to the entries. Perhaps the most important legislation of the year was that enacted by the people directly through their votes upon the numerous constitutional amendments submitted to them. The bulletin records the amendments defeated as well as those adopted, a special table arranged by States being inserted for convenient reference. It is of interest to note that of fifty-seven separate constitutional amendments voted on only twenty-four were adopted. It is proposed that the eighth bulletin shall consolidate into a single series with the legislation of 1897 the summaries for the preceding seven years.

A History of Ancient Greek Literature, by *Gilbert Murray* (New York: D. Appleton & Co., 1897, $1.50), forms the initial volume of the Literatures of the World Series. Edited by Edmund Gosse, who writes the general introduction, the aim of the series is to present "a succession of attractive volumes, dealing with the history of literature in a single country," not from the point of view of the specialist treating certain epochs, but giving a survey of the general evolution of thought expressed in artistic form. The object being primarily to give a biography of the intellectual life of a race, "an effort will be made to recall the history of Literature from the company of sciences which have somewhat unduly borne her down—from philology in particular, and from political history. . . . Literature will be interpreted as the most perfect utterance of the ripest thought by the finest minds, and to the classics of each country rather than to its oddities, and rather than to its obsolete features, will particular attention be directed." Homer stands, then, at the head of Greek literature, as being the oldest classic extant in the language. Much attention is given to the historians, and the drama, of course, is extensively treated, as are also the song-writers, whereas less space is accorded to philosophic and political writings. The author has in every case endeavored to get at the personality of the Greek writers and to set down their work as the result of the strenuous life of the people. The chapter on the later literature, Alexandrian and Roman, showing the rich fruitage of its declining years, in poetry up to the sixth century A. D., and in prose to the fall of Byzantium, proves that Greek literature by no means died with the loss of Greek independence, as is commonly assumed.

Dr. *George A. Williams* has prepared a revised and enlarged edition of his *Topics and References in American History*. The topics begin with the prehistoric period and come down to the election of 1896. Each has one or more references to standard works or to leading magazines, and lists of questions are inserted from time to time. In choosing his references the author has recognized the recent demand that students of history shall go "back to the sources." (Bardeen, $1.)

In a pamphlet on *The Energy of Living Protoplasm*, Prof. *Oscar Loew*, of the Imperial University, Japan, seeks to define that elusive mystery, the source of vital activity. Starting from the observation that the chemical properties of dead and living cells are totally different, and that certain substances, toxic to living protoplasm, have no

effect whatever on common proteids, he has made a study of the formation of albumin in plant cells, and finds there is a labile or *active* albumin in living matter chemically unlike the ordinary albumin stored in seeds and eggs. This exists as a reserve material in plants and undergoes chemical change by the same influences causing death to protoplasm. By many experiments it is shown that the chemical activity of cells is akin to the phenomena of catalysis. The conclusion is reached that there is an oscillation of atoms, or peculiar mode of motion, existing in labile proteids which is the source of *vital activity;* this being in its turn "but one of the vicissitudes of solar energy." (Keegan Paul, Trench, Trübner & Co., London.)

The Bureau of Navigation of the United States Navy Department has issued a chart of twelve colored plates showing a *Classification of Clouds for the Weather Observers of the Hydrographic Office.* It is for sale at 40 cents.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Connecticut: Tests of Plant Food. Pp. 11.—Iowa: Stomach Worms affecting Sheep. Pp. 4.—New York: Sample Road Building. Pp. 2.—North Dakota: Climate and Crop Service. June, 1897. Pp. 8.—Purdue University, Indiana: Formalin for Prevention of Potato Scab. Pp. 20. —United States Department of Agriculture: The San José Scale and its Nearest Allies. By T. D. A. Cockerill. Pp. 20.—Wyoming: The Composition of Prepared Cereal Foods. Pp. 16.

Archibald, Douglas. The Story of the Atmosphere. New York: D. Appleton and Company. Pp. 194. 40 cents.

Atwood, John. Constituents of the Universe. San Diego, Cal.: J. E. Friend. Pp. 65.

Abbe, Cleveland, Editor. Monthly Weather Review, April, 1897. Washington: United States Department of Agriculture. Pp. 64. 10 cents.

Bailey, L. H. The Principles of Fruit Growing. New York: The Macmillan Company. Pp. 508. $1.25.

Bell, Alexander Graham. The Science of Speech. Washington: The Volta Bureau. Pp. 56. 50 cents.

Bulletins, etc., of Scientific Societies. Colorado State Agricultural College: The Birds of Colorado. By W. W. Cooke. Pp. 143.—Field Columbian Museum, Chicago: List of Mammals from Somaliland. Pp. 155, with plates.—Tokyo, Zoölogical Society of: Annotationes Zoölogicæ Japonensis. Vol. I, Parts 1 and 2. Pp. 72.—University of Upsala, Sweden: Bulletin of the Geological Institution Edited by J. Sjögren. Vol. II, Part 2, No. 4. Pp. 172.

Christi on, J. Sanderson, M. D. Crime and Criminals. Chicago: The W. T. Keener Company. Pp. 116. $1.

Clayton Air Compressor Works, New York. Compressed Air and the Clayton Air Compressors. Pp. 106.

College and School Catalogues, etc. Baltimore Medical College: Annual Announcement, 1897–'98. Pp. 31.—Columbia University College of Physicians and Surgeons: Announcement, 1897–'98. Pp. 57.—The Neff College of Oratory, Philadelphia: Booklet and Prospectus. Pp. 48. —State Normal School, Valley City, N. D.: Announcement, 1897–'98. Pp. 46.

Hepner, Adolf. Centenary of Faust Zueignung. Goethe's Dedication of Faust. The Author: 806 Chouteau Avenue, St. Louis. Pp. 16.

Hopkins, T. C., and Siebenthal, C. E. The Bedford Oölitic Limestone of Indiana. Indianapolis. Pp. 427.

Jones, Jenkin Lloyd. Ten Noble Poems. Chicago: Unity Publishing Company. Pp. 48. 25 cents.

Mathews, F. Schuyler. Familiar Features of the Roadside. New York: D. Appleton and Company. Pp. 269. $1.75.

Mystic Oral School. Report to the Legislature of Connecticut. Pp. 8.

Newman, K. Antisepsis Intestinal. Maniera de Realizarla (Intestinal Antisepsis; How to Effect it). Santiago de Chile. Pp 21.

New Orleans Catholic Monthly. Memorial Number of Archbishop Janssen. Pp. 27.

Reid, G. Archdall. The Present Evolution of Man. London: Chapman & Hall. Pp. 307.

Reports and Memoirs. Alabama Geological Survey: The Valley Regions. By Henry McCalley. Part II. Coosa Valley, Montgomery. Pp. 862, with map.—The Fish and Fishes of the Coastal Waters of Florida. Washington: Fish Commission. Pp. 80.—Henry Draper Memorial. Miscellaneous Investigations. By H. C. Pickering and M. Fleming. Cambridge, Mass.: Harvard Observatory. Pp. 90, with plates.—Iowa Geological Survey. Vol. VI.: Lead, Zinc, Artesian Wells, etc. Pp. 487.—New Jersey: Annual Report of the State Geologist for 1896. Pp. 377, with maps.—Peabody Museum of American Archæology and Ethnology: Cave of Loltun, Yucatan. By Edward H. Thompson. Pp. 24, with plate. —Tennessee: Sixth Report of the Bureau of Labor, Statistics, and Mines, 1896. By A. H. Wood. Pp. 318.—Wisconsin: Sixteenth Report of the State Board of Health. Pp. 198.—United States Bureau of Ethnology: Fifteenth Annual Report, 1893–'94. Pp. 856.—United States Commissioner of Labor. Eleventh Annual Report, 1895–'96: Work and Wages of Men, Women, and Children. Pp. 671.— United States Life-Saving Service, 1896. Pp. 553. —United States Weather Bureau: Report of the Chief. Pp. 266.

Reprints. Davis, William Morris, and Curtis, G. C. The Harvard Geographical Models. Boston: Society of Natural History. Pp. 24, with plates.—Drummond, Andrew T.: Some Workingmen's Problems. Pp. 8.—Franklin Institute: Discussion on the Smoke Nuisance and its Regulation. Pp. 76.—Mearns, Edgar A.: Descriptions of Six New Mammals from North America. Pp. 6.—Merriam, C. Hart: A New Fur Seal or Sea Bear (*Arctocephalus Townsendi*) from Guadalupe Island, Lower California. Pp. 4.—Ries, Heinrich: The Fuller's Earth of South Dakota. Pp. 3; The Clays and Clay working Industry of Colorado. Pp. 5.—Shufeldt, R. D.: On Fossil Bird Bones obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee. Pp. 6.

Rodkinson, Michael L. New Edition of the Babylonian Talmud. Vol. IV. New York: New Talmud Publishing Company. Pp. 40.

Taber, Henry M. Faith or Fact. New York: Peter Eckler. Pp. 347. $1.

The Temple. July, 1897. The Rosy Cross. By Rosicrucian. Denver, Col.: The Temple Publishing Company. Pp. 30. 10 cents.

Tucker, Gilman H. Education from a Publisher's Standpoint. American Book Company. Pp. 23.

Fragments of Science.

Ups and Downs of the Tussock Moth.—After the English sparrows had quite exterminated the voracious measuring worms that used to make our city trees naked, the uneatable tussock moths took advantage of the opportunity and filled the trees for a few years with their uneatable larvæ. Now the tussock moths have nearly disappeared, and A Study in Insect Parasitism, by L. O. Howard, entomologist of the Department of Agriculture, tells us how it came about. It appears to be a kind of process of Nature that as soon as any living thing becomes numerous parasites find it, and shortly reduce it to its normal proportions or below. These in turn are subject to secondary parasites which keep them in check. Thus twenty-one parasites have been found upon the tussock moth, with fifteen hyperparasites. While, after having passed its culmination in the farther Eastern cities, the proportion of tussock moths has been about the same, it took a rapid and enormous increase in Washington in 1895. But the parasites appeared in force with the third generation of that year; and when in September several species of trees had been cleared of leaves and others badly injured, "it was an exception to find a healthy caterpillar which one of them was not engaged in stinging." There was a moderately abundant hatching of caterpillars in 1896, but the parasites were ready for them, and the first generation was practically exterminated by them. In the later months of 1896 the hyperparasites took their turn, and the tussock-moth caterpillars were not so hard to find, but were still rare. Even where parasites do not step in to keep down increase, the excessive multiplication of animal pests is at length inevitably checked by disease. Thus the chinch bug has no parasites, "but when it increases beyond the bounds of what may be called Nature's law, for want of a better term, bacterial and fungous diseases speedily carry it off."

Objects of National Forestry.—The policy and aims of those who are seeking the establishment and maintenance of a national forest policy have been misunderstood and misrepresented; and the misapprehension has been strengthened by some glaring defects in some of the forest laws, which the friends of forestry do not approve and desire to have remedied. It is not by their work, but contrary to their intentions, that these laws embody no provisions by which citizens can obtain wood from the public domain by purchase, and that timber-stealing flourishes under their operation. The laws which they propose are designed to remedy these evils. Reservation is the first purpose sought in them, regulation of the use of the timber the second; perpetuation of a valuable resource for coming generations the object. The programme of those urging these laws, as defined by Mr. B. F. Fernow, chairman of the American Forestry Association, is to withdraw from sale or entry all lands not fit or needed for agriculture and to constitute as objects of special care by the Government the lands at the head waters of streams and on mountain slopes in general; to permit prospecting, mining, and other operations under such regulations as will prevent unnecessary waste, and to cut and sell the timber under such methods as will secure perpetuation and renewal of the forest growth; to provide for protection against fire, theft, and unlawful occupancy; to respect all existing vested rights and arrange an exchange, if necessary, for private lands included in reservations; and, finally, to restore to the public domain for entry all lands that are found in the reservations fit for agriculture. The interests of the miner, the lumberman, the settler, and every citizen in the present and the future are regarded in the policy they advocate; the free herding of sheep, by which forest tracts are destroyed and rendered unfit for renewal, being the only industry not considered. "Just like the proverbial incompatibility of the goat and the garden, the growing of wool and wood on the same ground is incompatible."

Sewage Purification by Filtering.—Filtration through the soil is regarded by M.

Vincey, of the French School of Agriculture, as hygienically and economically the most perfect. The work is done through the nitric oxidation of nitrous organisms effected, independent of vegetation, by special microbes contained in the soil. The nitrates thus formed, combined with the very soluble bases contained in the earth, are taken up as foods by plants or carried off in drainage waters. The purifying quality of the soil is not augmented by the production of crops upon it. The siliceous sewer beds of Gennevilliers, near Paris, dug up and ridged, without crops, are capable of absorbing and purifying 1,200,000 cubic metres of sewage per hectare (about two acres and a half) a year. Agriculture is regarded as of great importance in the economy of sewer beds, but not so much on account of its relations to purification as to the quantity of water which the ground can receive. The demands which the most thirsty crops can make upon the water constituents of sewage are, however, limited; and they absorb only a fraction of the amount poured upon the beds. M. Vincey's observations in the Agricultural Park of Asnières indicate that forest land is capable of usefully purifying at least as much water as the natural meadow; and it results from all the experiments that, for a like soil and equal volumes of sewage, a smaller surface of meadow or forest is required than, for instance, of kitchen-garden crops. Siliceous soils and sands free from marl appear to have the highest purifying qualities. Limestone formations, marls, clays, etc., are inferior in these properties. The longer a soil has been purifying sewer water, the fitter it becomes for continuing the work; for purifying irrigation multiplies the colonies of mineralizing ferments in the soil. Comparative examination of land in which the operation had been going on from ten to twenty years and of soil that was virgin to the process, showed that no nitrogen had accumulated in the earth in consequence of sewage irrigation. The smaller part of the mineralized matter passes into the crops, while the larger part is washed away.

Cycles and Dogs in War.—The utility of bicycles in military art having been demonstrated, men of war are now studying the means of contending against them and their riders. The mere overthrow of the instrument does not convey any great advantage, for the man is there, and possibly still standing, armed, and ready to fight. Dogs have so far seemed to be the most effective agents in this contention, and the large Danish dog has been selected as the animal most fit. About a thousand dogs are said to be under training in Berlin for this sort of warfare. They are taught to distinguish the uniforms of friends—German, Austrian, and Italian—from those of the enemy—French and Russian—and attack the latter, the legs of the sham "hostile" soldiers being well protected, of course, by stout buskins. As all the armies will have cycle troops, they will all have to have their trained war dogs; and then, when the attack has commenced, *La Nature* slyly intimates, and the dogs get mixed with the cyclists, they will leave the soldiers and go to fighting one another.

Hydraulic Blasting.—A meeting of the Manchester Geological Society is reported in Industries and Iron, at which a new hydraulic apparatus for breaking down coal in mines was discussed. Mr. James Tonge, who described the apparatus, called attention to the great danger attending the ordinary method of blasting in coal mines, and said that the numerous serious accidents from this cause had led the inventors to look for a safer process of loosening the coal. The new apparatus consists of a hydraulic cartridge, eighteen inches in length and three in diameter, and weighing thirty pounds, and a small but powerful hand pump fitted with a pressure gauge weighing about twenty pounds. The mode of using it is as follows: The coal is holed underneath the usual depth, and a hole drilled near the roof to about the same depth as the holing, in the same way as for blasting. After this the cartridge is placed in the hole and pushed to the back. No "stemming" is required. The pump is coupled to the cartridge, the suction pipe placed in a small bottle of water, and work commences. Very soon the gauge begins to show the rising pressure—half a ton, a ton, a ton and a half, two tons to the square inch. During this time a cracking sound is heard, indicating the shearing off of the coal at the back. The gradual way in which the work is done, without shock

or jar of any kind, prevents even the least damage to coal or roof, in striking contrast to the action of explosives. The time occupied is an important matter. It has so far been about twelve minutes. This time includes placing the cartridge in the hole, connecting to the pump, getting down the coal, withdrawing the cartridge from the hole, and getting to the next place. The advantages claimed for this process over the ordinary blasting are (1) larger and stronger coal, which means a better average price; (2) non-interference with the working of the pit, the coal being got down whenever required; (3) no damage to roof; (4) no dust; (5) and absolute safety from the dangers attending shot firing. In previous machines of this sort trouble has been had with the joints, but it is stated that this one is free from that fault.

Timbuctoo and Jene.—Mysterious and romantic visions of wealth and gayety have been associated for centuries with the name of Timbuctoo. Of numerous travelers who have ventured much to reach the city only a few have succeeded. Thus, according to a summary in the London Academy, Mungo Park visited it in 1805, but was drowned in the Niger shortly afterward. Major Laing reached it in 1825, after a three years' expedition across the desert, but was murdered on leaving it. René Caillié found it about the same time, and wrote a book about it. Davidson was murdered, and Richardson died in the desert on the way thither. Dr. Bart found his way into the city, but never stirred out of doors while there. Lenz visited it and wrote a description of his adventure. The late Joseph Thomson was planning a visit to Timbuctoo when he died. Now the Frenchman, Félix Dubois, has published one of the best descriptions we have of the mysterious city. Its position on the edge of the Desert of Sahara, and at the top of the great bend of one of the largest and most constantly navigable rivers of the earth, the Niger, defines its importance. Yet M. Dubois found it not the greatest or most interesting town in the region. It is surpassed by Jene, whose name is echoed in the Anglicised form Guinea. That city dates from the seventh century; was built, not by negroes or negroids, but by the Songhis, who migrated from Egypt across the Soudan more than twelve hundred years ago; and has wonderfully solid architecture of the Egyptian order. The present inhabitants of Jene, M. Dubois says, "resemble a palimpsest on which the first manuscript is dimly decipherable. Their oral traditions, their chronicles, and their dwellings all betray their Nilotic fatherland."

Three Masters in Science.—We merely mentioned, last month, the deaths of Prof. Julius Sachs, the botanist, and Prof. Carl R. Fresenius, the chemist. Prof. Sachs was best known by his Text-book of Botany, which is one of the standard works of the science, of first authority. He was also author of the *Experimental Physiologie*, a work of corresponding importance in its field, a history of botany, and a collection of lectures. He was born at Breslau, Germany, in 1832, and died at Wurzburg, May 29th. His first teacher was Purkinje. He taught at Prague, Marandt, Chemnitz, and Poppelsdorf, near Bonn, and was Professor of Botany at Freiburg and Wurzburg. The fame of Fresenius dates from so early a period in the century that one would be almost inclined to reckon him as of a past generation. He was born at Frankfort-on-the-Main in 1818, began the study of natural science very early, entered the University of Bonn in 1840 and that of Giessen a year later, and became Professor of Chemistry, Physics, and Technology at the Agricultural Institute in Wiesbaden in 1845. He was identified with that institution for the rest of his life. His best-known works are the Qualitative Analysis and the Quantitative Analysis, published in 1841 and 1846 respectively, which have passed through very numerous editions and have been translated into nearly every European language. M. Paul Schutzenberger, an eminent French chemist, died June 26th, at Mézy, France. He was born at Strasburg, the son of a lawyer, in 1829; studied medicine and then chemistry; was made professor of chemistry in the high scientific school at Mulhouse; then became adjunct director of the chemical laboratory of the Sorbonne and chief of chemical work in the Collége de France. In 1876 he was named titular professor of chemistry in this institution. For many years he directed the physical and

chemical school of the city of Paris. He was a member of the Academy of Medicine and the Academy of Sciences. His principal works were on the application of chemistry to animal physiology, coloring substances, fermentation (in the International Scientific Series), and the *Traité de Chimie Générale*, in seven volumes.

Primitive Drills.—We all know how difficult it is, even with the best tools we have, to bore a correct hole by hand in a hard substance. Vastly more difficult must this have been with primitive men, who had no tools except flints and bones and sticks. Yet, as Mr. J. D. McGuire observes in his study of the Primitive Methods of Drilling, the earliest remains of man are found associated with implements of his manufacture in which holes have been artificially perforated, the implements consisting generally of bone, ivory, or shell. During the cave period man had the implements called "batons of command," the use of which is unknown, which were bored with extreme care from reindeer horn, and are often carved with representations of animals or of man, often artistically done. These men could only fashion the rudest implements from chipped stone. At later periods of development beads of shell and stone were made of shapely forms and evenly perforated. Of such are the Indian wampum beads, which, according to Lawson's History of North Carolina, they managed "with a nail stuck in a cane or reed. Thus they roll it continually on their thighs with their right hand, holding the bit of shell with their left, so in time they drill a hole quite through it, which is a very tedious work." This describes the most primitive form of drill, except that men had not yet advanced to the nail. They used flints or bones or sticks, re-enforced with sand. Mr. McGuire's presentation of objects perforated with this sort of drill exhibits some specimens of fine work done in hard stone and applied to various purposes. The next development is the strap drill, in which a string or cord is wound around the stick, and when pulled back and forth produces corresponding alternations in the motions of the drill, and adds considerably to its power. To this was added a bow, the pulling and relaxing of which maintained the revolution of the instrument. An improvement on this was a disk, the momentum of which carried on the motion of revolution, and rewound in an opposite direction the string which had been unwound. When the bow was arranged so as to have an upward and downward motion on the stick, the pump drill was constituted, an instrument differing essentially from all other boring tools, relatively easy to work, which has been widely distributed. The Egyptian monuments bear frequent representations of the use of the bow and disk drills under different forms and with various modifications. The Egyptians, however, had copper and iron.

Birds and their Songs.—Whether birds inherit their song or learn it by imitation has been the subject of experiments which M. Flamel describes in *La Nature*. We know already that some species take up the songs of others, but it had not been determined whether they ever learned them at the expense of their native song. One of M. Flamel's correspondents had a sparrow, "brought up by hand," which, when put into a cage with finches and canary birds, took up the songs of all its companions, repeating them perfectly; and then, some captured crickets having been placed near it, adopted their chirp too, but never sang like a sparrow. Another correspondent was told by a gamekeeper of two linnets which he had taken from the nest when they were very young and kept at his home in a wood where there were no other birds of their species, but nightingales were abundant. The birds sang like nightingales. Of the somewhat varied repertory of songs of a certain species of linnet, this correspondent asserts that the songs are severally peculiar to certain well-defined localities. All the individuals in one of these districts have the same songs and the same number of songs, so that the fanciers in the city where he lives are acquainted with the songs of the several stations around and know just where to go to get birds to their liking. It follows from this that some birds, at least, learn their songs by imitation.

Sunlight and Bacteria in Rivers.—In view of the destructive effect of sunlight, especially of the blue to the ultra-violet rays,

upon bacteria in water, Prof. H. Marshall Ward would explain the comparative freedom of river waters under the blazing hot summer sun from bacteria as against the more abundant infection of the same waters in winter. Pasteur and Miquel found that the germs floating in the air are for the most part dead—killed, the author holds, like the germs in the air of the Alps, by the sun. Yeasts which normally vegetate on the exterior of ripening grapes are destroyed, according to Martinaud, if the heat be very intense; and Giunti has observed that the ingress of sunlight hinders acetic fermentation—a bacterial process. So the access of light appears to be inimical to the germination and develment of fungi of various kinds. The destructive rays may be cut off by color screens, and the protected germs can then sprout and develop as easily as if no light was playing upon them. Such color screens appear to the author to be common in Nature, where the spores and tender growing cells are compelled to begin their vegetative processes in the light. The green chlorophyll screen of ordinary plants may fulfill this purpose. When the typhoid bacillus falls into turbid, dirty water in summer, it finds a congenial propagating place. The dirt furnishes it food, absorbs heat to increase the warmth, and keeps off the hostile blue and violet rays.

The Appraisal of Books.—The subject of furnishing librarians and the public with some general, comprehensive guide to the character and real value of books is discussed by Mr. George Iles in a paper on The Appraisal of Literature, which he presented to the International Library Conference held in London in July. The task of selecting from the enormous mass of books now appearing daily to be bought or read is a bewildering one. How make it easier? Mr. Iles would reach the end by a system of shortened reviews, prepared and adjusted for the purpose—"a brief note of description, criticism, and comparison, written by an acknowledged authority, signed and dated, and placed where the reader can not help seeing it, both within the lid of the reviewed book itself and on a card next the title-card in the catalogue." If the book treats of a question in debate, fact and opinion should be carefully distinguished, and views of opposed critics might be presented. By this means the inquirer would know which book is best, or among the best of its kind; would be made aware of defects; would learn how one book can gainfully piece out another; and would gather indications of the periodicals or transactions which bring a story of discovery and research down to date. In a final line he might be told where detailed reviews are to be found. Persons qualified to undertake this business of appraisal might be found among professional reviewers, who could "boil down" their larger reviews and adapt them. The work might be placed under the direction of a central superintendency of the American Library Association; and in connection with it something might be done "to rescue from neglect the great books which, from such causes as the untimely death of their authors, or the sheer brunt of advertisement, are overlaid by new and much inferior writing." Starts have been made toward this work in such manuals as the Reader's Guide in Economic, Social, and Political Literature, the List of Books for Girls and Women and their Clubs, and the special lists of books on fine art and on music.

Man's Language to Animals.—The exclamations we use in driving and calling horses, oxen, cats, dogs, fowls, and other domestic animals are presented by Prof. H. C. Bolton in a paper on the subject as affording familiar illustrations of a language of peculiar characteristics, whose words are chiefly monosyllabic and disyllabic, and usually repeated in groups of three, utterly devoid of grammar, exclusively in the imperative mood, and consisting of words not found in the dictionaries, which serves as a ready and sufficient means of communication between man and the many races of animals under his subjection. It has little in common with the language used by the animals themselves, but is forced upon them by man and made comprehensible to them by constant repetition. The terms used are different in different countries. In thus controlling the actions of domestic animals by the voice, man makes comparatively little use of the language by which he communicates with his fellow-creatures, but employs a pe-

culiar vocabulary, a variety of singular terms comprising inarticulate sounds and musical calls, whistling, chirping, clicking, and other sounds not easily represented by any combination of letters of the English alphabet, or by musical notation. Prof. Bolton has collected these words from a considerably large number of languages, ancient and modern, describes them, and analyzes them so far as they are susceptible of analysis. He reaches the general conclusion that the terms are mostly corruptions of the ancient names of the animals, sometimes with a prefix signifying "come," with expressions that have become otherwise obsolete. They are all subject to the same influences that lead to the development of dialects, and, the language being unwritten, the changes are quite radical. An important feature mentioned, but not dwelt upon at length, is the musical intonation giving a special character often associated with the call. We are surprised that while the author says much about "puss" as a call for the cat, he does not even mention "kitty," which is used a hundred times as often.

Plants and their Insect Inhabitants.—Plants have a special interest to the entomologist according to the number of insect species they harbor, and the invasion which causes dismay to the gardener brings him joy—qualified, we are glad to say, if the plant is a valuable one, by sorrow for his neighbor's trouble. Miss Mary E. Murtefeldt, of Kirkwood, Mo., has found no better way of making the acquaintance of the insect fauna of a locality than to take up, one after another, its native or introduced plants and, keeping them under close observation from spring till fall, and perhaps for several successive years, note the species that visit them and the larvæ that subsist upon them, either exclusively or in common with other plants. Many weeds afford abundant harvests of this kind; one of the most productive of them is the cut-leaved ragweed (*Ambrosia artemisiæfolia*) of roadsides and fallow fields, every part of which—foliage, flower, leafstalk, stem, and root—sustains its own peculiar species, the majority of which do not occur on other plants. This plant is especially a mine of wealth to the microlepidopterist in the number, beauty, and variety of the species that are partially or wholly dependent upon it. Miss Murtefeldt names between forty-five and fifty species of five orders which she has found on this one plant. Perhaps one fourth of these are limited to the genus *Ambrosia*, and six or seven have been found only on *artemisiæfolia*.

MINOR PARAGRAPHS.

It is reported that an important advance in color photography has been made by M. Villedieu Chassagne and Dr. Adrien Michel Dausac. The process is simple and inexpensive. A negative is taken on a gelatin plate, which has been treated with a solution of certain salts (the nature of the solution is kept secret). The negative is developed and fixed in the ordinary way. From it a positive is printed on a sensitized paper which has previously been treated with the unknown solution. This positive is then washed over with three colored solutions—blue, green, and red—and it takes up in succession the colors in their appropriate parts, and the combinations of the colors giving all varieties of tints.

Berthelot and Vieille have recently been experimenting with acetylene, in reference to its explosiveness. They found that when acetylene at ordinary pressure is exposed to the action of the electric spark, a red-hot wire, or a fulminate shock, the gas is decomposed only in the immediate vicinity; when the gas is under pressure, however, the result is quite different, the acetylene acting as do the ordinary explosive mixtures when the pressure exceeds two atmospheres—the explosion rapidly spreading through the entire mass which, decomposes into hydrogen and finely divided bulky carbon. Liquid acetylene behaves in the same way. Using eighteen grammes in a bomb of 48·96 c. c. capacity, the final pressure was 5,564 kilogrammes per square centimetres—almost the equal of gun cotton.

Stress is laid by M. Albert Gaudry, in his study of Philosophical Paleontology, on

the increase of intelligence as a feature of animal development. First, there was progress in locomotion, and the sedentary invertebrates of Primary times were succeeded by the secondary reptiles, and they by the numerous Tertiary mammals. The continued improvement of the last was manifested in the gradual adaptation of the feet of the horse and deer, making them better fitted for speed. The power of sensation has also undergone a steady augmentation, and intelligence has been developed slowly and regularly. If, in the absence of other knowledge, we may judge concerning the nervous system of the invertebrates or of the Primary fishes from that of existing beings, we have to conclude that their intelligence was very imperfect. The forms of the brains of some of the Secondary reptiles, as revealed by molds of the interior of their skulls, show that they were very little advanced. By this criterion, the gigantic saurians were very stupid animals. A progressive development evidently took place during the Tertiary period. Finally, the brain of man, the latest, is the most complicated, the most voluminous, and at the same time the most condensed of all. The history of the world thus reveals to us a progress which has continued through the ages.

THE utilization of burned clays as a road material is mentioned in Mr. C. B. Keyes's last Missouri Geological Report as a subject that should be fully discussed. Some of the railroads are already using burned clay for ballast in preference to rock, sand, or gravel, with good results, so that the extension of the use of this material to highways is in reality beyond the experimental stage. Prof. Wheeler says in his report on clays that, while it is not so good as tough rock for the heavy traffic in cities, it would prove durable for country roads, where the teams are few and the loads light. It can be prepared wherever the clay is, and often by the roadside; and as the heaviest roads are those in clay soils, these may be made themselves to furnish the material for their own improvement.

THE failure of British girls' schools to achieve the results intended in scientific training was ascribed by Miss L. Edna Walter in the British Association to the two reasons that only the faculty of observation is, as a rule, cultivated, and that the work is not begun low enough down in the school. A gently graduated scientific course is, in the view of the author, wanted, beginning with the simplest experiments for young children, and gradually increasing in complexity till the girls reach the age of about sixteen. From beginning to end the course should be practical in character, and quantitative as far as possible. Such a course can be followed if practical arithmetic be made the starting point. This leads naturally to elementary physics, chiefly hydrostatics, and finally to a course of elementary chemistry. It is an important feature of the course suggested that the children should use no textbooks; their own notes written in their own language should form their books of reference. In this way their literary powers are cultivated; but, above all, they learn to rely upon themselves.

A REMARKABLE discovery has been made near Perm of an extensive burial place of the supposed old inhabitants of Russia, the Chuds, from which exceedingly rich collections of implements have been recovered. Among them are at least a hundred earthenware vessels, and "cart loads" of broken pieces of earthenware ornamented with all sorts of figures illustrating the life of the people. Of these are men sitting on horseback and in small boats, nine engravings of bees and flies, fifty-nine engravings of birds, more than a hundred of different mammals, and ten of snakes. Three masks and one head of mammals were also found, a large silver plate representing a man standing on some animal, eight smaller silver pieces, a hundred and forty-one bronze plates, several bronze statuettes, and "an immense number" of rings, stars, bells, small models of sledges, thimbles, arrowheads, hatchets, knives, nearly four hundred gilded bronze pearls, fishing hooks, skulls of stags, various carnivorous animals, etc.

IT is stated by Prof. T. F. Wright that recent exploration in Palestine clearly shows that all the ancient chronicles in regard to the wall of Jerusalem were trustworthy. It had a very strong wall, with frequent towers or bastions. The wall ran all around the brow of Zion Hill, crossing the Tyropœan

Valley, and then going northeasterly to the corner of the temple inclosure. As it will be represented on new maps, the present wall on the south side will be a nearly straight line, placed east and west, with a loop southward from its ends like a bow with cord loosened. The space between the straight and the curved lines has been very little explored as yet, but at the pool of Siloam Dr. Bliss has found the perfect formation of a very early Christian church, showing its whole plan. This place will be kept open, and will be one of the most interesting places in or near the city.

NOTES.

SOME funeral jars found in Arkansas exhibit representations of the human face which contrast greatly with the crude figures usually characteristic of Indian and even of American art, they being accurate in anatomy and physiognomy. From a study of them Mr. F. S. Dellenbaugh concludes that they can be accounted for without supposing some exotic or wonderful native artist, by regarding them as death-masks made by taking a mold of the face and transferring it to the jar.

THE effect of fasting upon the power of the system to resist infection from microbian toxines has been investigated by MM. J. Teissier and L. Guinard, and they find it a strengthening one. Animals which had been kept fasting bore out against inoculation much better than the control animals, and the resisting power seemed to increase with the length of the fast.

THE Russian thistle, concerning the introduction and spread of which in the United States much alarm was expressed a few years ago, is likely, if we can credit the reports from the Western States, to prove a comparatively harmless pest, after all. It does not thrive so vigorously as it promised to, but rather declines after a year or two. In some districts the dried weed was chopped up fine and fed to cattle; and it has proved to be good fuel, and is even said to be marketable for that purpose.

ANALYSES of the air taken in the ascension of the "Aérophile," February 18, 1897, at the height of fifteen thousand five hundred metres, made by MM. Schloesing and A. Muntz, show that the composition of the air at that elevation, as has always been supposed, does not differ materially from that of the air of lower regions.

A VERY interesting question was brought up in the British Association, in the discussion of a paper by Mr. W. Barlow on homogeneous structures and the symmetrical partitioning of them with application to crystals. Lord Kelvin remarked on the immense number of possible methods of partitioning space, and said that, although Schucke was generally credited with having been the first to investigate the subject, it had been thoroughly worked out by Bravais, whose mind gave way under its overwhelming complexity. Prof. Miers said there were two hundred and thirty types of symmetry and only thirty-two types of crystal, so that the same crystal might contain several types of symmetry.

A RAILWAY is to be built up the Hochstauffen Mountain at Bad Reichenhall, Austrian Alps, of which it is contemplated that a balloon shall be the propelling power. The balloon will run along a track, consisting of a peculiarly shaped rail. This is clasped by a trailer, furnished with many wheels, to which a passenger car is fastened. The operator has a seat in the car, and a cord swings between his place and the balloon, by which the gas supply is regulated; and provision is given under his control of brakes and devices for safety against accident. The gas generator at the foot of the railroad will supply the town with illuminating gas, as well as furnishing that with which the balloon is filled.

ARTERIO-SCLEROSIS is described by M. Huchard, in his treatise on Diseases of the Heart, as peculiarly the disease of physicians, politicians, and financiers, their liability to which is largely due to their practicing professions in which emotion is often intensified and which involve great liability to overwork. In addition, doctors have to experience unavoidable irregularities in hours, and sometimes continuous periods of work without rest. The single means of arresting and avoiding these consequences is by a diminution of anxiety and an avoidance of overwork, with measures taken as far as possible for repair of the wasted tissues.

DR. ALFRED MARSHALL MAYER died July 13th, after a protracted illness, in the sixty-second year of his age, at Maplewood, N. J. He had been Professor of Physics and Chemistry in the University of Maryland and in Westminster College, Missouri; Professor of Physics in Pennsylvania College, Gettysburg; Professor of Physics and Astronomy at Lehigh University; and, since 1871, Professor of Physics at Stevens Institute of Technology at Hoboken, N. J. In 1869 he had charge of one of the official parties sent out to observe the total eclipse. He was a member of seven scientific societies.

FRITZ MÜLLER, who died May 21st at Blumenau, Brazil, was best known by his book *Für Darwin*, enumerating facts in support of the Darwinian doctrine of the origin of species, which was translated into English. Darwin received also direct assistance from him in his investigations. He was the author of numerous memoirs on mimetism, coloration, etc.